



**Developing Young Thinkers:
Discovering Baseline Understandings of
Effective Thinking among Children and
Teachers and Intervening to Enhance
Thinking Skills**

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DECLARATION

This thesis has been composed by me and is entirely my own work. The publications arising from this thesis are included in the appendices. The joint authors and the publishers of the papers derived from the data presented here have granted permission for their inclusion.

Lynsey A. Burke

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ABSTRACT OF THESIS

This thesis considers teachers' and pupils' conceptions of effective thinking, and analyses how these are developed through an explicit thinking skills intervention. An analysis of children's concepts of intelligence has shown that, with age, children tend to associate 'cleverness' with knowledge acquisition rather than active thinking. Perhaps as a reflection of this it is increasingly popular to teach thinking skills in schools, although how best to support practitioners in this task remains contested. This thesis presents findings from three linked studies conducted to discover pupils' and practitioners' understandings of 'effective thinking' (which few research studies have attempted) before intervening to explicitly enhance children's thinking skills.

Study 1 was questionnaire-based and investigated teachers' definitions of effective thinking, their views of thinking skills taught within the curriculum and whether thinking skills are fostered developmentally. 127 questionnaires were returned representing teachers from 36 primary schools in central Scotland. A qualitative analysis of teachers' concepts indicated that many did not have a clear understanding of 'effective thinking'. Quantitative data indicated that practitioners believe thinking skills are more frequently integrated into some curricular areas than others and highlighted the lack of a developmental progression of thinking skills being taught throughout primary school.

In Study 2, 75 children were interviewed with 25 children from each of the following ages: 5, 7 and 11 years. This study explored the development of children's definitions of intelligence and effective thinking and the characteristics and causes associated with each. It also produced novel data on how children's knowledge of thinking skills changes over time. Content analysis revealed age trends in children's definitions of intelligence, as, with age, children were increasingly likely to hold cognitive views and incorporate knowledge into those definitions. Whilst no age trends were found in children's concepts of effective thinking, with all three age groups defining it as a cognitive ability, clear developmental trends emerged in children's understandings of individual thinking skills.

The final study (involving 178 primary 7 pupils and their teachers) challenged these concepts through an intervention designed to evaluate the effects of infusing thinking skills throughout the curriculum, and investigated the belief that collaborative learning enhances thinking skills. There were three intervention conditions: collaborative, individual and control. Six thinking skills were focused on, with training sessions and curricular lesson plans devised to support practitioners. The intervention lessons were based on an identified underpinning pedagogy of effective thinking (i.e., making the thinking skill explicit; fostering appropriate thinking dispositions; developing metacognition and encouraging transfer). The intervention evaluation utilised standardised and study-specific pre- and post-tests. Results demonstrated statistically significant gains for the individual and collaborative learning conditions in a range of thinking skills. The greatest increase in performance was seen in the collaborative learning condition.

These three studies highlight the importance of gathering baseline data on understandings of effective thinking before intervening to successfully develop awareness of the cognitive processes involved in ‘good thinking’ and enhance children’s thinking skills. The findings from this thesis have significant implications for education; practitioners need clearer guidance on how to teach a coherent developmental progression of thinking skills, and need to be supported when explicitly infusing thinking skills throughout the curriculum.

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CHAPTER 1

DEVELOPING EFFECTIVE THINKING WITHIN THE CURRICULUM

1.1 Aims of this Thesis

This thesis will argue that ‘effective thinking’ is an ability that is central to a child’s development and provide evidence that it is a capacity that can be nurtured in all children. In addition to a child’s parents/guardians, the teacher can often play a significant influencing role in a child’s formative years. Teachers therefore have the responsibility of ensuring they are modelling and developing appropriate knowledge, skills and attitudes. To achieve this, it would be important that policy documents, curriculum guidelines and staff training reflect and emphasise fundamental skills and dispositions associated with effective thinking. In this respect, practitioners’ teaching style and strategies can therefore be expected to develop in response to national priorities. If these aims are to be realised, there is an important role for research into children’s and practitioners’ perceptions of effective thinking within the curriculum. Teachers can then be given explicit training with regard to deepening children’s conceptual understanding of the cognitive processes involved when applying specific thinking skills. Similarly, teachers’ awareness needs to be raised regarding the importance of modelling appropriate thinking dispositions, developing metacognition and encouraging learners to transfer thinking skills and habits to other areas of life.

There is still a strong debate among theorists as to which skills and attributes are involved in effective thinking. Various frameworks have been created which try to conceptualise and connect different types of thinking and these will be discussed later in this chapter. Whilst a large body of research has concentrated on identifying practitioners’ and children’s concepts of intelligence (to be discussed in Chapter 2), less emphasis has been placed on uncovering concepts of effective thinking.

Analysing the relationship and overlap between these two phenomena deserves further attention, as ‘being intelligent’ is often accepted to be a matter of ‘thinking effectively’. Another debate in the past has arisen between theorists advocating teaching thinking skills as a discrete subject, and those arguing for thinking skills to be infused throughout the curriculum. This thesis explores the value of enhancing teachers’ methodologies to foster effective thinking, rather than developing teachers’ aptitudes to teach resource-led thinking skills programmes. Chapter 3 aims to distil core elements of effective thinking that can form the basis of a broad, comprehensive pedagogy that teaches for thinking explicitly throughout all curricular areas. This present chapter will contextualise these central themes of this thesis by placing them in a wider educational perspective, and specifically explore the phenomenon of effective thinking.

1.2 Introduction

One of the traditionally accepted aims of education has been to transmit content knowledge, and as such, learners have been viewed as passive entities accumulating facts and information (e.g., Ashman & Conway, 1997; Costa, 1989; Resnick & Klopfer, 1989a). Resnick notes that, “The idea that knowledge must be acquired first and that its application to reasoning and problem solving can be delayed is a persistent one in educational thinking” (1987, p. 48). Despite some advice being offered within recent 5 – 14 curriculum guidelines in Scotland, the issue of passive learning and the emphasis on transmitting subject content was not resolved. In response to this, the aim in Scotland now is to create successful learners, confident individuals, responsible citizens and effective contributors (Scottish Executive, 2004). Similar emphases have emerged in other parts of the UK (e.g., DfES, 2002). In line with this recognition, the teaching of ‘thinking skills’ is now widely promoted in schools. As will become evident from the three empirical studies presented in this thesis, for teaching practices to realise policy aims, practitioners need to be supported; the transition from policy to practice will not happen unaided. When practitioners do not fully understand the rationale behind initiatives, or are not aware of how to alter their teaching practices to reflect national policies, the learners in their care are unlikely to fully benefit from theoretical intentions. This thesis will

demonstrate the value of understanding teachers' and children's perceptions of effective thinking before attempting to deepen them and enhance this ability through an intervention.

1.3 Thinking Skills in the Primary Curriculum

The primary curriculum is generally structured so as to reflect pivotal theories in education and as such is regularly undergoing development. In Scotland, national guidelines for the curriculum from 5 –14 were developed between 1987 and 1991 and, with some revisions, have remained in force until now. 'The National Priorities in Education', articulated in 2000, have recently focused attention on five identified core aspects underpinning the educational system. The most relevant one for the purposes of this thesis is priority five – *To equip pupils with the foundation skills, attitudes and expectations necessary to prosper in a changing society and to encourage creativity and ambition* (Scottish Executive, 2000a). The 5 – 14 curriculum in Scotland is currently being revised following the publication of the policy document *A Curriculum for Excellence* (Scottish Executive, 2004) that strongly reflects these priorities. It is also becoming clear in responses to nationwide discussions on the new curriculum strategy that thinking skills are being identified as a key way to respond to the challenge of *A Curriculum for Excellence* (2006a). This recognition was partly spurred by the work of McGuinness (1999), who was commissioned to write a report by the DfES to review and evaluate the role of thinking skills in educational environments. She concluded that children should explicitly be taught skills to help them think better, that developing thinking dispositions was an integral part of fostering 'effective thinking', and that children's metacognitive ability should be cultivated. She also highlighted the benefits of collaborative learning and I.C.T. when directly teaching thinking skills, and noted the difficulties associated with ensuring thinking skills and dispositions are transferred to other contexts. With regard to recent evaluations of thinking skills programmes, McGuinness summarised various methods as follows:

The more successful approaches tend to have a strong theoretical underpinning, well-designed and contextualised materials, explicit pedagogy and good teacher support.

(1999, p. 1)

1.3.1 The 5 – 14 Guidelines

The 5 – 14 curriculum was devised in 1991 in Scotland, prior to the emergence of ‘thinking skills’ as an explicit educational priority. That is not to say, however, that thinking opportunities are not highlighted to practitioners within these guidelines. This is not surprising, as the idea of teaching thinking is by no means a new development (Nisbet, 1990). Furthermore, as Sternberg and Baron argue:

...the ultimate goal of education has been to teach children to think critically and independently. Hence, there is nothing faddish about educators’ current interest in thinking skills, nor about the necessity of finding integrated ways to teach and test them.

(1985, p. 40)

By way of example, within the Scottish curricular guidelines for Environmental Studies (Scottish Executive, 2000b), the document encourages opportunities to be provided for children to, “ask questions, experiment, design and make, solve problems, sort and categorise things into groups” (p. 14). Mathematics (Scottish Office Education Department, 1991a, p. 3) is seen as:

...an activity involving processes such as discovering, discussing, ordering, classifying, generalising, drawing and measuring where it is recognised that pupils enter school as active thinkers.

In the rationale for English Language (Scottish Office Education Department, 1991b, p. 3), teachers are directed to provide opportunities in:

Thinking: for example, speculating; hypothesising;
discovering; reflecting; generalising; synthesising;
classifying; evaluating.

In the Personal, Social and Development guidelines (Scottish Office Education Department, 1993a, p. 27), pupils are encouraged to:

...reflect upon, evaluate and express their opinion about values held by the school and community; apply a problem tackling process in relevant situations; initiate, organise and complete tasks involving others; set and review personal goals at regular or appropriate times; demonstrate their ability to select from an increasing range of choices and to discuss the reasons for the choices made.

Furthermore, in the Expressive Arts guidelines (Scottish Office Education Department, 1993b, p. 2), teachers are encouraged:

To promote pupils' cognitive development by including questioning, reasoning, problem-solving and decision making; creative, imaginative, divergent thinking; gaining, selecting and using information.

However, whilst there is not a substantial conflict of interest between following the 5 – 14 guidelines and simultaneously developing effective thinking (Kirkwood, 2005; Logan, 1993), the guidelines do not *explicitly* direct practitioners to teach children thinking skills. For instance, although the above illustrations cite the intention to promote 'creative thinking' and 'decision making' for instance, little explanation is offered to practitioners regarding the cognitive processes involved in each of these types of thinking. Therefore, although in Scotland these 5 – 14 documents inform most school policies and inspections, few practitioners refer to them for their daily practice needs, as the documents are widely regarded to lack detail in terms of managing practicalities within general constraints. Recent policy documents (e.g., DfES, 2002; Scottish Executive, 2004) have consequently focused attention on the need to teach explicitly for effective thinking and to ensure that curricular content can justify itself in terms of creating independent, responsible and creative learners.

1.3.2 The Need for *A Curriculum for Excellence*

Although the majority of schools in Britain and elsewhere acknowledge the importance of 'thinking' and consequently are keen to take ownership of the thinking skills initiative, many schools found certain aspects of the 5 – 14 curriculum difficult

to reconcile. The structure of the curriculum has the potential to either inhibit or enhance the incorporation of any initiative designed to foster effective thinking. Whilst policy makers and practitioners regularly disagree about certain aspects concerning the content and structure of the curriculum, both parties are often unified through their dissatisfaction with it. As Kelly notes, "...nothing has been more significant or as fundamental as the major modifications that have been made to the curriculum" (1989, p. 1). This is perhaps not surprising as the curriculum is the main vehicle through which a child's learning will be driven. Kelly reinforces this when he suggests that curriculum changes can make an important difference to teaching practices and the quality of learning. As such it is beneficial to regularly evaluate and reflect on the teaching and learning process, and continually identify areas for improvement. It is through recent evaluations that the 5 – 14 curriculum in Scotland came under scrutiny.

The curriculum rationale document, *The Structure & Balance of the Curriculum* (Scottish Executive, 2000c), states its main principles as being breadth, balance, continuity, progression and coherence, which will be used to promote 'high-quality' learning and teaching. The 5 – 14 curriculum has succeeded in encouraging teachers to see beyond the importance of the two dominant curricular areas, maths and language. It has enabled teachers to look more broadly at individual subjects by identifying numerous strands, targets and skills for each subject, and has promoted an equal balance within and between all possible subjects. In theory, this provided a basis for ensuring that teachers throughout Scotland are providing all learners with equal access to the curriculum, irrespective of individual teachers' preferences. Unfortunately, this has simultaneously created a somewhat rigid and inflexible structure for which the allotted 20% flexibility factor does not compensate. It is commonly acknowledged that the compartmentalised subjects with strict time allocations have often made teachers feel suffocated and restricted. This difficulty reflects a point made by Elvin, prior to the formulation of the 5 – 14 guidelines, that (1977, p. 34):

Young children should be encouraged to follow where their curiosity leads and not shut off an interest because they are not doing that subject now...When you are out walking, nature does not confront you for three quarters of an hour only with flowers and in the next only with animals.

A problem for education is that isolating subjects in this way can make it difficult for children to make both inter-subject links and feel the impact of these school subjects on their everyday lives. Furthermore, new elements have been added to the curriculum, which means that teachers have to teach more subjects and content over the course of a week. This problem is not faced solely by those involved with the Scottish educational system and curriculum, but with those concerned with educational policy internationally. For example, Ashman and Conway (1997, pp. 7 - 8) state:

In many cases, curriculum content is fixed, and there may be few chances for the teacher to select topics or activities that are motivating for both high and low achieving students. In many secondary schools, for example, teachers must cover a prescribed curriculum regardless of the interests or specific characteristics of the learner group (e.g., predominant cultural or socio-economic background).

It is perhaps due to the very extensive content to be transmitted in such a short space of time that a certain style of teaching remained common; that of didactic or transmission teaching where the children are receptive and passive learners. As Costa (1989, p. vi) notes:

Parents and politicians have come to judge schools and educators by their ability to impart more knowledge sooner and faster: Teachers are thereby persuaded that the more content covered, the more effective is their teaching.

Furthermore, Best (1982, p. 293) states:

Too often education stifles creativity and individuality and consists merely in learning and regurgitating facts, so that students leave the Education Supermarket with carrier-bag minds neatly filled with pre-packed ideas.

It was only relatively recently that the difficulties and problems associated with the 5 – 14 curriculum were publicly acknowledged and the pressure placed on teachers recognised by HMI officials and head teachers (though there were earlier academic critiques, e.g., Kirk & Glaister, 1994). In November 2002, Jack McConnell, First Minister, called for, “greater curriculum flexibility”. Similarly, the curriculum was criticised by head teachers and practitioners as being, “too complex and confusing” (Munro, 2003, p. 1). These difficulties have implications for the success of interventions designed to effect change within classroom practices, and will also be discussed further in Chapter 3.

In light of these reflections, in Scotland, the National Debate in Education prompted the creation of five National Priorities in Education, referred to earlier in this chapter. *A Curriculum for Excellence* is the vehicle through which these priorities are to be realised and it is hoped that this new curriculum will formally emphasise aims such as, “working together, creative thinking, problem-solving and critical thinking” (Henderson, 2002, p. 1). Unlike the 5 – 14 curriculum, this pared down curriculum gives practitioners full permission to focus less on transmitting content knowledge and gives time to allow teaching methodologies to reflect various initiatives such as:

- Assessment is For Learning (AiFL): For example, promoting high interaction in classrooms based on thoughtful questions and reflective responses, involving pupils and staff in deciding next steps in their learning and identifying who can help (e.g., Scottish Executive, 2006b)
- Enterprise in Education: Encouraging learners to develop a ‘can-do’ attitude to provide positive solutions to real life challenges (e.g., Enterprising Careers, 2005)
- Citizenship: Making informed choices and decisions, encouraging children to take action, individually and as part of collective processes (e.g., LTS, 2002)
- Race Equality: Promoting good practice that enables young people to prepare for life in a multicultural and multiracial Scotland, developing positive values and attitudes, thinking critically about equality and fairness (e.g., HMIE, 2004)

- **Thinking Skills:** Developing creative and critical thinking skills, problem solving and decision making strategies and the dispositions to apply them in various contexts.

The essence of the above initiatives is intended to be reflected through the core attributes and capacities of learners within ACE. However, for practitioners to foster successfully the ethos of each of the above initiatives, and to realise the broader aims of ACE, awareness needs to be raised about what it means to be an ‘effective thinker’.

1.4 Definitions and Characteristics of Effective Thinking

The complex nature of effective thinking means that a single definition does not exist. Resnick (1987), however, believes that higher order thinking (which is seen as being synonymous with effective thinking) is easy to identify in various contexts. Some broad characteristics of higher order thinking that Resnick mentions are that it is complex, effortful and involves self-regulation and the active search to find meaning. She warns about the dangers, however, of adopting the title ‘higher order’ skills. She argues that this umbrella term is potentially misleading as it can promote the view that there are ‘lower order’ skills which ought to be mastered first. This view, she notes, “justifies long years of drill on the “basics” before thinking and problem solving are demanded” (p. 8).

Covington proposes the phrase ‘strategic thinking’ as encompassing “the self-conscious planning, organising, and orchestration of one’s personal resources such as ability” (1983, p. 155), and therefore, like Resnick, stresses the importance of self-regulation. Similarly, Pithers & Soden (2000. p. 238) summarise a variety of literature that defines ‘good thinking’ as the ability to:

...identify questions worth pursuing, being able to pursue one’s questions through self-directed search and interrogation of knowledge, a sense that knowledge is contestable and being able to present evidence to support one’s arguments.

Moseley et al. recently defined thinking as, “a consciously goal-directed process”, and following the Oxford English Dictionary defined ‘skill’ as, “Skill commonly means ‘expertness’, ‘practical ability’ or ‘facility in doing something’” (2004, p. 7). However, within their definition of thinking skills, they were also equally keen to promote “unconscious” and “internalised” rudiments of thinking.

Within these more broad definitions of effective thinking or ‘strategic’ thinking, it is generally accepted that specific characteristics of higher order thinking include the promotion of many of the following thinking skills; comparing and contrasting; predicting; analysing; evaluating; concluding; solving problems; making decisions; finding reasons; and classifying (Ennis, 1987; Kirkwood, 2001; McGuinness, 1999; Moseley et al., 2004; Swartz & Parks, 1994). As Lipman states, “The list is endless because it consists of nothing less than an inventory of the intellectual powers of mankind” (2003, p. 162).

Many definitions of effective thinking therefore involve the thinker identifying a goal, deciding on which strategies to use to reach it, actively performing mental operations in a search to find meaning, and then reflecting on how well those mental operations were performed. These general similarities notwithstanding, as Beyer notes, “In what they choose to discuss or to teach as thinking skills, educators today continue to exhibit both haziness and great diversity” (2001b, p. 35). He argues that many problems exist in the teaching of thinking skills. Firstly, the definitions of individual skills are so vague that they could be understood differently in different educational contexts. Secondly, that the terminology used to denote various thinking skills can often vary considerably. Furthermore, some skills are inaccurately called ‘thinking’ skills as they simply require the learner to passively recall facts. Finally, Beyer argues that educators typically engage in “skills overload”. One consequence of this is that (p. 39):

All too often, thinking skills that are introduced at one grade level are never reinforced or practiced in subsequent grades...Because coherent, sequential instructional programs that focus on thinking skills are not widely available, teachers usually find it impossible to relate their teaching efforts to those of teachers in previous or subsequent grades.

Ensuring a clear developmental progression occurs would therefore seem important when fostering children's thinking skills.

One of the broad themes running throughout this thesis is the relationship between effective thinking and intelligence, and particularly whether children and teachers are aware of the link between the two concepts. At the theoretical level, many of the above capacities cited in definitions of effective thinking are also incorporated into theorists' definitions of what it means to be intelligent. For example, two major reviews of psychologists' definitions of intelligence have been conducted this century, the first of these occurring in 1921, and the second in 1986. Sternberg (2000; 1986) believes that underlying components of intelligence (according to psychologists) are revealed through an analysis of these reviews (2000, p. 8):

Adaptability to environment, basic mental processes, and higher order thinking (e.g., reasoning, problem solving, decision making) were prominent in both listings.

However, whilst metacognition was barely mentioned in the 1921 review, in 1986 psychologists/experts rated it as being one of the most fundamental aspects of intelligence (Sternberg, 2000). Even more recently, fifty-two experts' views on intelligence were also combined and summarised by Gottfredson, (1997, p. 13) who, consequently defined intelligence as:

...a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience.

This provides explicit links to metacognitive skills ('plan' cited above), critical thinking skills ('ability to reason' mentioned above), information processing skills

(‘comprehend complex ideas’) and problem solving strategies, all of which will be discussed further below.

However, whilst thinking skills are integrated into the majority of experts’ views of intelligence, the precise relationship between these two concepts remains contested. Some theorists explain the link between intelligence and thinking skills by reasoning that thinking skills enhance intelligence, and therefore conclude that intelligence can be taught (e.g. Herrnstein, Jensen, Baron, & Sternberg, 1987; Shayer & Adey, 2002; Sternberg, 1987a; Tishman, 1995). Grotzer & Perkins (2000) state, “Intelligent behaviour is typically supported by a repertoire of intelligent thinking processes” (p. 493). Furthermore, Sternberg (1987a) claims that one of the reasons intelligent people ‘fail’ is because there is a “lack of balance between critical, analytic thinking, and creative, synthetic thinking” (p. 213). The previously assumed positive correlation between a person’s IQ and thinking ability is now refuted by many experts in the field, who claim that a person may be intelligent (in the traditional sense of the word), yet may not be an effective thinker, able to make decisions and solve problems (e.g., Baron, Granato, Spranca, & Teubal, 1993 and Klaczynski, Gordon, & Fauth, 1997 in Grotzer & Perkins, 2000; De Bono, 1976). It remains problematic whether developing thinking skills simply enhance the intellectual processes being practised, or whether they enhance general intellectual ability. As Winne states (1989, p. 51):

...it is plausible to view thinking skills as components of intelligence. This is not to say that cognitive skills are intelligence or that they are all of whatever intelligence is, but neither does this deny that possibility.

Although further clarification is needed on the overlap between the concept of effective thinking and intelligence, it is outwith the scope of this thesis to contribute to this debate. For the purposes of this thesis, however, thinking skills will be viewed as core components of intelligence. Investigating teachers’ and children’s understandings of intelligence (and determining the extent to which thinking skills are incorporated into those definitions) is necessary to establish if children are aware of the thinking processes they can employ to enhance their intelligence. An analysis

of these concepts will be presented in the following chapter. Moreover, if the literature suggests that teachers and pupils are unaware that ‘being clever’, involves applying thinking skills and dispositions, this has implications for educational interventions seeking to develop intelligence. As the responsibility to implement classroom interventions generally lies with the classroom teachers, this suggests that their concepts of intelligence and effective thinking must be explored before asking them to intervene to deepen children’s concepts.

At this juncture it is important to state that, at a fundamental level, not all theorists agree that the ability to think can be broken down and taught by its component skills, or that there are ‘general thinking skills’ which can be taught outwith subject content. It is a view contested by many philosophers. For example, Johnson (2001) argues that developing effective thinking by teaching thinking skills is a ‘reductionist approach’, because, “mastery of the so-called ‘sub-skills’ still leaves the learner well short of mastering the whole” (p. 7). Furthermore, many philosophers believe thinking to be entirely domain-specific, and that general thinking skills do not exist (McPeck, 1981, McPeck, Martin, Sanders & Slemon, 1989). However, this important issue of domain-specificity, which some theses could focus on entirely, will not be addressed in this thesis. The areas for investigation in this thesis instead involve the use, development and enhancement of thinking skills in children and across subject areas. As such, the third intervention study has followed previous research studies (e.g., Adey, 2002; Edwards, 1991; Edwards & Balauf, 1987; McGuinness, 2005a) that teach and measure general thinking skills explicitly in a variety of contexts. For the purposes of this thesis therefore, general thinking skills (including self-regulation/metacognitive abilities and cognitive skills), will be seen as central components of the concept of effective thinking, something which has been strongly defended by many educational theorists. Furthermore, that these are often recognised to sit within a wider conceptual framework including thinking strategies and dispositions.

Thinking Skills Frameworks

Many proponents of the thinking 'skills' approach have exemplified their definitions of effective thinking by categorising thinking skills into broad hierarchical frameworks (e.g., Anderson & Krathwohl, 2001; Ashman & Conway, 1997; Bloom, 1956; Marzano, 2001; McGuinness, 2003; Swartz & Parks, 1994; or see Moseley et al., 2004 for a review of frameworks). These frameworks all differ to a greater or lesser extent in terms of the precise terminology of skills. They also vary regarding whether they are purely 'cognitive skill' frameworks or whether they take a more holistic view of thinking by detailing relevant self-regulative/metacognitive capabilities and dispositions for good thinking. Categorisations of 'thinking skills' are therefore a contested area. There are many such lists of supposed skills, with many overlaps and not all are mutually consistent. Research on thinking would benefit from further conceptual clarification in this regard. It is outwith the scope of this thesis to do justice to all, or even some, of the thinking skills frameworks in circulation. Therefore, only the most relevant frameworks for the purposes of introducing the empirical studies in this thesis will be discussed.

One of the first widely accepted definitions of core elements of effective thinking is promoted in Bloom's Taxonomy, where he categorises a hierarchy of fundamental cognitive objectives as being: knowledge, comprehension, application, analysis, synthesis and evaluation (1956). The latter three of these objectives are commonly accepted to represent higher order thinking abilities. Whilst some frameworks resist the transition from theory to practice, Bloom's Taxonomy has managed to transcend the gap successfully. It is currently being promoted in educational environments (e.g., IDCTE, 2006), even though there have now been revisions published intended to supersede the original (e.g., Anderson & Krathwohl, 2001; Marzano, 2001). Anderson and Krathwohl's version retains Bloom's original six categories but rewrites them in verb form and slightly changes the order so that they become; remember, understand, apply, analyse, evaluate, and create. The intention is for this taxonomy to be as teacher-friendly as the first. Anderson & Krathwohl (2001) do not claim that the categories in the revision form a static hierarchy, with the learner only being able to move to the next level once the 'cognitive process' skills in the

previous category have been mastered. The revision also includes four separate knowledge categories; factual, conceptual, procedural and metacognitive, all four of which can be actively employed throughout the cognitive process dimensions. These four new categories reflect change in recent decades from knowledge being viewed simply as passive content to be transmitted (and which often becomes inert), to an active and reflective dimension within the learner's skills (Perkins, 2001).

Marzano (2001) has also designed a new taxonomy based on Bloom's original. Like Anderson & Krathwohl (2001), he recognises the need for knowledge to be represented as a more dynamic concept (for instance in its importance when making decisions and solving problems). The main difference with his version is that he reworks the framework to become a three-tier hierarchical structure of the self, metacognitive and cognitive systems. The cognitive system is seen to include knowledge utilisation, analysis, comprehension and retrieval. Although Moseley et al's (2004) critical analysis of this framework points out that Marzano places a larger emphasis on critical thinking skills than creative thinking skills, within the category of 'knowledge utilisation', decision making, problem solving and investigation are promoted, which would undoubtedly involve the learner in creative thinking.

Numerous frameworks have been devised and promoted since Bloom's categorisation. Moseley et al (2004) carried out an analysis of 55 of these in a bid to highlight unifying factors amongst the superficially vastly differing models. They contend that all frameworks are able to fit into one of the following categories; all-embracing frameworks, instructional design frameworks, frameworks for understanding critical and productive thinking, and models of cognitive development. They found that out of the 55 frameworks analysed in detail, 26 of them dealt purely with cognitive skills and only 14 frameworks dealt with cognitive, affective and conative skills combined. In response to this meta-analysis and upon discovering that no one framework was all-encompassing, Moseley et al. (2004) devised their own framework that they believe is a prototype into which all other frameworks can fit. Their two-tier model differentiates between strategic/reflective thinking, and cognitive skills i.e. information gathering (recall and recognition),

building understanding (which they explain is a more positively worded version of 'basic thinking skills') and productive thinking (active engagement in problem solving, creative thinking and reasoning – decision making is not mentioned). They have been thorough in ensuring their framework subsumes all other models analysed, and their model clearly demarcates the difference between self-regulated/metacognitive abilities and cognitive abilities (something which they point out that other frameworks do not all accomplish). However, whilst they intend their framework to highlight the importance of motivation and appropriate dispositions when developing effective thinking, these crucial aspects are lost under broader all-encompassing headings. It is possible that, in their quest to ensure that their framework covers every possible base, it is consequently lacking in its ability to be a clear and concise workable framework that will make a difference to the quality of teaching and learning in schools.

Two frameworks devised with the intention to sit alongside educational teaching pedagogies are those of Swartz & Parks (1994) and McGuinness (2003) (the McGuinness framework is a more recent derivation of the Swartz & Parks model). Both of these frameworks highlight the importance of core types of thinking skills that they believe should be infused into the curriculum, and as such, represent theoretical frameworks devised with practical implementation in mind. These purely skills frameworks are intended to sit within a wider pedagogical framework, which will be analysed in detail in Chapter 3. Both frameworks are similar in that they promote five main types of thinking: critical thinking, creative thinking, clarification and understanding (Swartz & Parks' terminology)/searching for meaning (McGuinness' terminology), problem solving and decision making. McGuinness, however, clearly places metacognition at the heart of her version, something which Swartz & Parks incorporate only in the lessons devised to help put the framework into practice. Neither framework explicitly highlights the importance of thinking dispositions to enhance the use of these skills. However, these frameworks have not been published as discrete entities from the handbooks alongside which they sit, and both handbooks mention the importance of thinking dispositions being promoted in conjunction with appropriate thinking skills.

One framework that has been specifically formulated to sit alongside educational policy is the thinking skills framework devised to support the National Curriculum in England and Wales (DfES, 2002). In the National Curriculum, the types of thinking skills promoted fall into five categories, namely information processing, reasoning, enquiry, creative thinking and evaluation. It appears that the broad category of 'evaluation' is not intended necessarily to imply evaluation of the thinking, but of the task content. Therefore, one fundamental type of thinking is not represented explicitly – metacognition/self-regulation. Similarly, whilst the main thinking types of creative thinking, critical thinking ('reasoning' cited above) and information processing are covered, core thinking strategies such as decision making and problem solving are only promoted indirectly within the 'enquiry' skills category. Furthermore, it is only a skills framework and does not extend to dispositions and motivation, unlike more holistic theoretical models. As this model was designed specifically for the curriculum and to be a guide for practitioners to make thinking skills explicit in their teaching, it is surprising that these are not specifically promoted. Similarly, as it is a curriculum model, and as guidelines for other curricular areas tackle the field developmentally, it might have been more useful and practical for a curricular thinking skills framework to give more guidance on how to teach thinking skills by mirroring age-related changes in cognition, rather than leaving the individual curricular guidance documents to promote the thinking skills in isolation.

Summary of Frameworks

A few of the most pertinent frameworks in relation to this thesis have been discussed, each of which has differed slightly in various ways, for instance in the terminology of skills promoted, the extent to which they take a more holistic view of thinking, and whether hierarchies are evident. Ashman & Conway (1997) believe that the majority of programmes designed to teach thinking focus on developing metacognition, critical thinking, creative thinking, core thinking skills, cognitive strategies (such as problem solving and decision making) and emphasise the role of content knowledge. A synergy exists therefore between these broader thinking types noted by Ashman and Conway and the frameworks of Swartz and Parks (1994) and

McGuinness (2003). A hierarchy is often distinguishable within these thinking types as it is generally accepted that pupils will use creative, critical and information processing skills when solving problems and making decisions. Furthermore, each of these thinking processes will be enhanced when learners are able to 'think about their thinking' (metacognition) with a view to improvement. Therefore, although the thinking skills within these frameworks may be promoted as skills to be focused on individually, a proficiency in one skill is often dependent on an ability in another (e.g. one cannot be a successful creative thinker without being able to think critically about the ideas generated). In this respect, age appropriate teaching of thinking skills is as relevant as it is in other curricular areas, where effective learning depends on structured continuity and progression of skills. As this thesis is looking at frameworks suitable to be promoted in educational environments, the models of Swartz & Parks and McGuinness will be used as the basis for the empirical studies. Furthermore, there is a wealth of evidence to support the inclusion of each of the thinking types they highlight within their frameworks. The individual thinking types promoted within these frameworks will now be scrutinised.

1.4.1 Metacognitive Skills

As was highlighted in the previous section, common to all recent definitions and models was the importance of metacognition (i.e., Anderson & Krathwohl, 2001; Marzano, 2001; McGuinness, 2003; Moseley et al, 2004). Before learners can become critical or creative thinkers, make good decisions and solve problems skilfully, they must have control of their thought processes. They must be able to identify appropriate types of thinking for a given task and plan how to use that style of thinking by detailing the thinking steps likely to be involved in the operation. When the task-related thinking is taking place, learners must recognise the importance of analysing their thinking. This could potentially mean redirecting their thinking once they have assimilated the results of the monitoring process and perhaps found that their thinking has lost focus and deviated from the task. After the 'on-task' thinking has taken place, it is essential that learners engage in metacognitive reflection to evaluate the thinking processes they carried out. This evaluation could consider time scale, relevance to task-objectives, effectiveness of strategies used,

particularly successful moments and identify future areas for development. Developing learners who are metacognitively aware at all stages of a task (i.e. before, during and after) is a fundamental prerequisite for developing all other cognitive thinking skills. These aforementioned three key stages involved in metacognitive thought are widely accepted to represent the essence of metacognition (e.g., Beyer, 1987; Borkowski & Thorpe, 1994; Costa, 2001). Whilst it is recognised that metacognition can occur on varying levels of consciousness (Nickerson, Perkins, & Smith, 1985), many theorists advocate the benefits of making these metacognitive strategies explicit to learners within subject content (e.g. Beyer, 1987; Costa, 1981; Duell, 1986; Kirkwood, 2005; McCombs & Whisler, 1997; McGuinness, 2003; Nickerson et al., 1985).

Flavell (1971 in Brown, 1987) instigated much of the research on metacognition with his inquiry into meta-memory. The concept of meta-memory has expanded and been superseded by the broader term ‘metacognition’, which is now more frequently used and is seen as encompassing meta-memory. More recently, Flavell summarised that, “Metacognition is usually defined as knowledge and cognition about cognitive objects, that is, about anything cognitive” (1987, p. 21). In terms of the specific cognitive operations associated with metacognition, Nickerson et al. (1985) summarise some metacognitive skills identified by other theorists as (p. 103):

planning, predicting, checking, reality testing, and monitoring
and control of one’s own deliberate attempts to perform
intellectually demanding tasks.

In relation to monitoring thinking, Costa (2001, p. 409) explains that it involves both ‘looking ahead’ and ‘looking back’. Brown, (1987), also understands metacognition to refer to knowledge about cognition and the regulation of cognition. Many educationalists encompass the concept of ‘self-regulation’ within their definitions of metacognition as it is important to develop children’s ability to self-regulate their learning and understand that they have control over what they learn and how well they learn it (Meece, 1994). This might include allowing children to direct areas for study, and allowing learners to complete work in whichever order they choose. Pintrich’s framework (2000) consists of four categories through which learning can

be regulated, that is, cognition (including metacognition), motivation, behaviour and context. Costa & Kallick (2004) believe that for a pupil to become a 'self-directed learner', the core aspects of self-managing, self-monitoring and self-modifying must be apparent.

It is commonly accepted that metacognitive ability increases with cognitive ability. A deeper analysis of this relationship has shown that more sophisticated metacognitive ability appears to be a prerequisite for more sophisticated cognitive ability (Swanson, 1990 in Larkin, 2002). This evidence points to the importance of ensuring that teachers have a secure understanding of this correlation and a deep knowledge of ways to foster metacognition through an appropriate teaching methodology. Furthermore, as metacognition is understood to increase with age and practice (e.g., Flavell, 1987), teaching styles should be tailored to meet developmental changes in metacognitive ability, much as a teaching style is tailored to meet developmental changes in cognitive ability.

In addition to raising teachers' awareness about the need to foster metacognition to enhance cognitive ability, it is important that practitioners also understand the relevance of a pupil's motivation to achieve and propensity to model appropriate dispositions. Research has shown that these elements play a key role in determining the extent and rate of metacognition (Borkowski, Carr, Rellinger, & Pressley, 1990; Larkin, 2002; Paris & Winograd, 1990; Sternberg, 1998).

1.4.2 Critical Thinking Skills

In the USA, the term 'critical thinking' is seen as being synonymous with 'thinking skills', and many definitions of it also encompass creative, problem solving and decision making skills. However, for the purposes of this section, the type of thinking known as 'critical thinking' will be defined as a discrete entity and separate from creative thinking, for example, which will be dealt with in the forthcoming sections.

McPeck (1981) states that, “it is not at all clear that people mean the same thing by critical thinking, nor that they would all continue to approve of it if they did agree about what it meant” (p. 1). Yet it is, he suggests, widely accepted as being distinct from imaginative and creative thinking. According to Fisher (1990), developing critical thinking skills involves children in, “learning how to question, when to question and what questions to ask, and learning how to reason, when to use reasoning and what reasoning methods to use” (p. 66). Bailin (1998, p. 204) also places the ability to reason at the centre of her definition of critical thinking and describes the specific characteristics of:

...active learning, independent thinking and personal autonomy and reasoned judgement in thought and action, and these particular goals are grounded in broader views regarding knowledge, reason and the person.

Whilst, as Bailin notes, a shared definition of critical thinking does not exist amongst theorists, she believes that the ability to reason is widely regarded as being one of the most important aspects of critical thinking cited in philosophical analyses. Facione (1998) in ‘The Delphi Report’ summarised the core cognitive skills concerned with critical thinking (according to a panel of experts in the field) as being interpretation, analysis, evaluation, inference, explanation and self-regulation, all of which needed to be combined with relevant affective dispositions. He states; “The ideal critical thinker can be characterised not merely by her or his cognitive skills but also by how she or he approaches life and living in general” (p. 8). Dispositions cited included being inquisitive, truthseeking, open-minded and confident in reasoning.

Ennis defines critical thinking as, “reasonable reflective thinking that is focused on deciding what to believe or do” (1987 p. 10). His most recent taxonomy of critical thinking (which has evolved over time) includes what he perceives as all higher order thinking skills grouped into 15 types of abilities (Ennis, 1998). Many of the 15 abilities are then subcategorised with a more detailed list of criteria. Examples include the ability to analyse arguments, judge the credibility of a source, induce and judge inductions to explanatory conclusions, identify unstated assumptions, make and judge value judgements, integrate the other abilities and dispositions in making

and defending a decision and follow problem solving steps. He also promotes three overarching dispositions, each of which is made up of subcategories; care that a belief is true; care about representing a position clearly and honestly; and care about the dignity and worth of every person. Ennis views the first two of these dispositions as being fundamental to employing the abilities effectively.

Halpern (1997, p. 4) defines critical thinking as:

the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is used to describe thinking that is purposeful, reasoned, and goal directed.

She expands on this by explaining that an aptitude for critical thinking is essential to skilful problem solving and decision making. Halpern's view of critical thinking skills, like many other theorists', therefore encompasses a wide spectrum of higher order skills, which also includes creative thinking, thought and language, deductive reasoning and memory skills. She justifies the inclusion of 'memory skills' (which is less commonly included within critical thinking frameworks) by explaining that, "all thinking skills are inextricably tied to the ability to remember" and expands on this by linking the "pervasive influences of memory" to "how and what we think" (1997, p. 19). Unlike some categorisations of critical thinking skills, the criteria listed within each broad thinking type is in simple practitioner-friendly language, and has the potential (like the frameworks of Bloom, 1956 and McGuinness, 2003) to make the transition from theory to practice. Like other theorists, Halpern reiterates the importance of developing appropriate dispositions (she lists six as being fundamental) and views them as 'essential components' to the development of critical thinking skills. However, she is not as explicit in her account of these as others have been.

Paul (e.g. 1991) makes a distinction between 'strong sense' critical thinking (involving the development of 'micro' skills, 'macro' abilities and, most importantly, appropriate 'traits of mind') and 'weak sense' critical thinking (which often does not efficiently teach micro-skills, macro abilities and typically would not encourage children to develop appropriate thinking tendencies). He argues that, too often, learners employ critical thinking skills to advance their own case single-mindedly,

without considering the possible merits of a conflicting viewpoint. This is an example of weak sense critical thinking. Paul (1991) argues that there are nine necessary traits (e.g. 'intellectual curiosity' and 'fair-mindedness'), which, when combined with appropriate cognitive strategies (such as 'giving reasons and evaluating evidence and alleged facts' and 'refining generalisations and avoiding oversimplifications') collectively represents strong sense critical thinking. More recently, Paul & Elder (2004, p. 1) have defined critical thinking as:

...self-directed, self-disciplined, self-monitored, and self-corrective thinking. It requires rigorous standards of excellence and mindful command of their use.

Paul's model of critical thinking has continually evolved, and the latest version stipulates the need for four essential categories to be developed to ensure strong sense critical thinking is taking place, with the end result that one becomes habitually a critical thinker (1993). These most recent core aspects have superseded the macro abilities and micro skills, and the four key sections he now promotes includes elements of thought/reasoning (e.g. be clear about the purpose for reasoning, identifying assumptions), abilities, affective traits (e.g. intellectual fair-mindedness, perseverance, courage and a sense of justice) and intellectual standards (e.g. precision, logic, relevance and depth).

1.4.3 Creative Thinking Skills

Traditionally, critical thinking and creative thinking were thought to be distinct and entirely separate types of thinking. This originated from the view that critical thinking occurred most frequently in the left brain, and creative activities in the right. This view has been questioned by contemporary research on the brain which suggests that the integration of the left and right brain is essential to all types of effective thinking (LTS, 2001, p. 19):

Promoting critical thinking is one key to fostering creativity. It is now generally accepted that the traditional separation of 'intelligence' and 'creativity' was mistaken. Critical thinking and creative thinking are not at odds. Although distinguishable, they are interconnected and rely on each other.

Proponents of this theory include Perkins (1990), Swartz (1987) and Nickerson (1999). Yet to a certain extent, in schools, many practitioners still encourage learners to 'be creative', without promoting the connection to critical thinking.

Various theorists have recently questioned the current curriculum's ability to develop creative individuals, and declared the need for creative thinking skills to be taught explicitly to all children (e.g. Robinson, 2001). In Scotland, the fifth national priority in Education, and the recent publication of 'Creativity in Education' (LTS, 2001) has helped to raise awareness of the potential for all children to leave school being able to think creatively.

Guildford's pivotal paper (1950) defined the core aims of creative thinking as being four-fold, that is, to encourage fluency, flexibility, originality and elaboration of ideas. Torrance (Torrance & Ball, 1984) has since used these as the basis for his widely recognised tests of creativity. Cropley (2001), on the other hand, singles out three ultimate priorities for a creative endeavour, that there is a sense of novelty, that it is effective and that its purpose is ethical. He also stresses the crucial role that personality and environment play in creative activities. Perkins (1990) and Claxton and Lucas (2004) concur that successful creativity is inextricably linked to personality, confidence, enjoyment and motivation. Sawyer (2006), however, does not agree that the concept of 'originality' needs to be present in order for a work to be considered creative. He argues that all works involve adapting previously formulated thoughts and ideas, and that a person can be engaged in a creative process without necessarily producing a completely novel and original piece of work, unrelated to previous creative endeavours. Robinson's definition that creativity involves, "imaginative processes with outcomes that are original and of value" (2001, p. 118), concurs with Sawyer's that the concept of originality can be person and culture specific; a creative product may involve originality for the person, a community or for humanity.

In general, however, the majority of definitions of creativity do emphasise 'novelty', 'originality' or 'unusualness' (Cropley, 2001; Perkins, 1990; Poole, 1979; Swartz &

Parks, 1994). To this end, many educationalists believe the strategy ‘brainstorming’ (a concept originally formulated by Osborn, 1953) to be at the heart of stimulating novel outcomes, when used appropriately (Fisher, 1990; Rapp, 1967; Rawlinson, 1981; Robinson, 2001; LTS, 2001; Swartz & Parks, 1994). Brainstorming is seen as encompassing the attributes of thinking up as many ideas as quickly as possible, not judging or criticising ideas, combining ideas and encouraging originality of ideas (Nickerson, 1999). Whilst the phrase ‘brainstorming’ is commonly used in many environments (both in education and outwith), the rules promoted to ensure the strategy of brainstorming is as effective as possible are possibly not as widely known. When trying to develop ‘originality’ and ‘novelty’, some theorists advocate the utilisation of a strategy which can often follow on from brainstorming, a method which encourages the thinker to blend and combine ideas from different categories (e.g., Swartz & Parks, 1994; or ‘network thinking’, Miller, 1992 in Cropley, 2001).

Theorists such as Cropley (e.g. 2001), Claxton (e.g. 1998), Rubin, (1967), and Poole (1979) have been instrumental in portraying the potential all learners have to be involved daily in creative activities. The difficulties, as stated in the Learning & Teaching Scotland document (2001), arise when practitioners find it increasingly harder to reconcile their ideals associated with creative classrooms (such as fostering imagination, risk-taking and openness to new ideas), with the constraints of the curriculum (such as current pressures on assessing children’s work, and covering topics in limited time). This is something which ACE seeks to address.

1.4.4 Information Processing Skills

All creative and critical thinking opportunities are conducted with the thinker searching for some sort of meaning and understanding in their work. Often, before decisions can be made and problems solved, the thinker has to interact with the content and clarify concepts. Swartz & Parks (1994) have called these ‘clarifying and understanding’ skills, and include thinking skills such as comparing and contrasting, sequencing and classification within their category. McGuinness details a similar list in her classification of this thinking type which she entitles, ‘searching for meaning’ skills. Many theorists highlight the importance of these types of skills

in their frameworks as being crucial in developing understanding (Ashman & Conway, 1997; Beyer, 1997; McGuinness, 2003; Moseley et al., 2004; Swartz & Parks, 1994). As Beyer argues (1987, p. 16):

Thinking, in its broadest sense, is the search for meaning...Thinking, in short, is the mental process by which individuals make sense out of experience.

These core skills encourage the learner to interact with knowledge and information, rather than acquire facts passively. These skills are thus an important precursor to applying critical and creative thinking skills. This is reflected in the 5 – 14 curriculum where most of the skills introduced at an early age ask children to compare and contrast, classify, identify parts and wholes and sequence.

1.4.5 Decision Making and Problem Solving Strategies

Whilst it may initially appear that some frameworks corroborate the view that decision making and problem solving are discrete entities, separate from critical and creative thinking, on closer inspection it becomes apparent that critical, creative and information processing thinking skills are fundamental to the success of skilful decision making and problem solving strategies. As Huitt (1998, p. 5) states:

In today's rapidly changing context, it is solving real problems and making correct decisions that is valued, not simply demonstrating a narrow set of skills in a highly structured academic setting.

Decision making and problem solving skills are similar in that, to be skilful in each of them, an aptitude for being a critical and creative thinker is a necessity. Both decision making and problem solving are also similar as they involve the learner stating a clear goal, generating possible outcomes/strategies, looking at the possibilities in detail, making a decision/selecting a solution strategy and evaluating. Whilst some theorists (e.g. Swartz & Parks, 1994) treat both of these strategies similarly and promote them through the same terminology (for instance, in a problem solving situation asking the learner to consider consequences and pros/cons of a particular option), the majority of theorists argue that these two strategies involve

different cognitive processes, and as such, these processes need to be reflected accurately in the terminology of steps involved in the strategy (Beyer, 2005a).

Although it is widely recognised that successful decision making and problem solving rely on the utilisation and integration of critical, creative and clarifying skills, many theorists place an equal amount of importance on the ability of the thinker to display appropriate thinking dispositions when applying the strategies (e.g. Costa & Kallick, 2000; Ennis, 2001; Halpern, 1997; Swartz, 2001b) and also to reflect metacognitively on how effectively they have applied the strategy (Duell, 1986; Flavell, 1976; Kirkwood, 2005; Kluwe, 1987; Larkin, 2002; Sternberg, 2001; Swartz, 2001b).

Decision Making Skills

The ability to make good decisions is a fundamental life skill. From a young age children are given practice at making decisions, although their first introduction to decision making is likely to be on a relatively insignificant level with few long term major consequences (e.g. choosing what to wear to a party or deciding which activities to play at golden time in school). As children develop, however, they will be required to make more important and potentially life-changing decisions (e.g. which subjects to choose at high school, whether to go to a parent's funeral or not, choosing whether or not to succumb to peer pressure). Therefore, just as with age children are given more responsibility for making important decisions, so this needs to be reflected in the number of quality opportunities children are given to practise skilful decision making in a variety of contexts.

It is generally accepted that there are fundamental elements that need to be present to ensure decision making is conducted skilfully. For instance, most theorists state the importance of the learner identifying the reason why a decision needs to be made, brainstorming a number of options, predicting consequences, judging the importance of the consequences by weighing up the pros and cons and only then making the 'best' choice (Beyer, 1997; Costa & Kallick, 2001; Halpern, 1997; Kirkwood, 2005; Leigh, 1983; Perkins, Goodrich, Tishman, & Owen, 1994; Swartz, 2001b; Swartz &

Parks, 1994). Working through these specific steps will counteract the chance of biased and rash decisions being made.

Problem Solving Skills

Similarly, amongst effective problem solvers certain traits are evident. The ability not simply to be reactive when a problem appears, but to be proactive and enthusiastically search for potential problems is often a characteristic found in successful problem solvers (Sternberg, 2001). The need for the next generation to demonstrate a ‘can do’ attitude to problem solving is a reflection of the increased need for learners who can apply and adapt solution strategies in response to novel and challenging situations. Learners therefore need to be equipped with fundamental skills, strategies and dispositions that will enable them to reach solutions successfully.

The goal of becoming an ‘independent thinker’ is one which Polya (2004) views as being a main objective when providing problem solving opportunities. His framework for working through problems in the context of mathematics is coherent, clear and generalisable. As such, it is a model that has influenced other fields (Kirkwood, 2005; Lochhead & Zietsman, 2001). The four phases he proposes are; understanding the problem, devising a plan, carrying out the plan and examining the solution. Other theorists have devised similar models that involve the student identifying the problem, generating alternative solution strategies, selecting a solution strategy, listing the steps involved, carrying out the plan (where appropriate), and evaluating and checking the effectiveness of the strategy (Beyer, 1997; Jackson, 1989; Marien, Viskocky, & Chapman, 2001; Marzano, 2001; McGuinness, 2003; Sternberg, 2001). For the stage ‘generating solutions’, for some problems it may be appropriate for learners to consider applying previously learned generalisable strategies, for instance, drawing a graph, working backwards or trying a simpler case (Andre, 1986; Halpern, 1997; Nickerson et al., 1985; Polya, 2004; Robertson, 2001; Swartz & Parks, 1994). However, these strategies are probably best suited to mathematical problem solving. Equally often, this stage involves learners in thinking laterally and using their creative thinking skills to generate

alternatives, many of which may not be ‘tried and tested’ problem solving strategies. Therefore many types of problem solving tasks, then, are inextricably bound to creative thought (Cropley, 2001; Nickerson et al., 1985; Sawyer, 2006). In a similar vein, other theorists discuss the necessity of ‘insight’ and ‘inspiration’ to solve certain types of problems that require a concentrated amount of perseverance (Andre, 1986; Perkins, 2001; Robertson, 2001).

1.5 Thinking Skills Interventions

In terms of fostering thinking skills in educational establishments, *A Curriculum for Excellence* is in the early stages of its development, and, as discussed previously in this chapter, many schools had attempted to foster effective thinking whilst still being constrained by the difficulties of the 5 – 14 guidelines and prior to the formulation of the new curriculum. Theorists’ views of effective thinking have been discussed in this chapter. However, it is also important to gather data on how teachers and learners perceive ‘effective thinking’ and their knowledge of individual thinking skills before intervening to induce change. Although this has been hinted at in this chapter, it will be concentrated on in Chapter 2. A number of programmes are currently circulating in educational establishments to develop children’s thinking skills. Whilst these will be presented in detail in Chapter 3 of this thesis, the following sections highlight the dominant ways to teach thinking skills and the rationale for each.

1.5.1 Summary of Different Approaches to Integrate Thinking Skills into the Curriculum

In general, there are two main ways in which local authorities and individual schools have embarked on ‘teaching thinking skills’ (see Chapter 3 for a discussion of approaches). Many began by utilising prepared thinking skill programmes and viewing ‘thinking’ as a discrete subject to be given its place amongst already established curricular subjects, such as mathematics and language. In these instances it is common for practitioners to teach a pre-set series of lessons. Programmes based on this approach include, Philosophy for Children (Lipman, e.g., 1982, 1985), Instrumental Enrichment (Feuerstein, 1980), Cognitive Research Trust (De Bono,

1976, 1981, 1985) and 'Let's Think' (Adey, Robertson, & Venville, 2001). However, one of the major problems associated with teaching thinking discretely is that, as has been mentioned, the 5 – 14 curriculum was already overcrowded with discrete subjects being taught often with no apparent connections being made between skills and content taught in the individual subjects.

Other schools have decided to infuse thinking skills into subject content already taught, and followed the advice of educational theorists such as Resnick and Klopfer (1989a), Beyer (1987; 1997), McGuinness (e.g., 2000a; 2003) and Swartz (e.g., 1987). These theorists and approaches are more intent on effecting change within effective learning and teaching methodologies. The focus in this approach is on explicitly teaching for thinking within curricular subjects and promoting a thorough pedagogy of effective thinking.

It is an assumption of this thesis that change will be more likely to occur when teachers are trained in the underlying pedagogy of effective thinking, rather than training teachers on how to implement a finite resource. Whilst many of the thinking skills programmes available in education incorporate elements of effective thinking to a greater or lesser extent (see Chapter 3), many of them do not explicitly foster aspects which are widely accepted to be essential attributes of an effective thinker, something which many theorists advocate (i.e., making the thinking skills learned explicit, cultivating appropriate thinking dispositions, developing metacognition and fostering transfer).

1.5.2 Goals of Intervening to Challenge Understandings

In view of the aims and considerations discussed above, it seems important to analyse current practice regarding thinking skills within schools. Whilst the 'thinking skills initiative' is relatively new, previous curricular guidelines and policies have attempted to develop pupils who are effective thinkers, albeit in a less explicit way. The extent to which practitioners have integrated this aim into their daily classroom practices is currently not known. Similarly, pupils' understandings and experiences of 'thinking' in schools may be vastly different to those expected as

a result of the implementation of educational policies and resulting teaching methodologies.

Of most interest for education is the extent to which classroom practices not only deepen these concepts of effective thinking, but most importantly, attempt to effect change in thinking skills ability. A valuable objective when discovering teachers' and pupils' concepts of what it means to be a good thinker, is that a targeted intervention can be structured to challenge concepts and enhance teachers' awareness of how to develop children's thinking skills. The teacher is the pivotal factor in determining the success of classroom interventions. Nisbet takes this a step further by saying (1991, p. 184):

We cannot expect to teach thinking if the teachers themselves are not thinking... It is tempting to suggest that it is the teachers who should study the programmes on thinking skills so that they can then apply the principles through infusion into curriculum generally.

It is crucial, therefore, that teachers have a sound understanding of the rationale underpinning educational initiatives, before they will be evidenced in the classroom. In connection to this, perhaps the most important piece of advice comes from Elmore (1999). He warns that, although schools are forever adapting to implement various initiatives, it does not mean that a change in ethos has taken place because schools, "never change in any fundamental way what teachers and students actually do when they are together in classrooms" (p. 255). He explains that entrenched methodologies of teaching practice are seldom influenced by initiatives, and therefore have little impact on student learning. He explains (1999, p. 258):

But the fundamental problem I am interested in is why, when schools seem to be constantly changing, teaching practice changes so little, and on so small a scale.

To make sure this does not happen, it can be argued that various systems need to be put in place. Wallace (1999, p. 238) advocates implementing a two-pronged training cycle:

- 1) For presentation of theory, demonstration, practice and feedback in the training setting; 2) For practice, feedback and coaching in the job – transfer of learning.

Transfer of learning into the classroom situation presents one of the main difficulties when implementing initiatives. It has already been mentioned that teachers are under great pressure from the current demands of the curriculum. Therefore if teachers and children are expected to change what they do in the classroom to a significant degree, the support they are given must demonstrate, on a practical level, the most effective way to integrate core elements of policies into their teaching methodologies. This might involve, for example, peer tutoring/coaching, modelling and observing lessons, regular feedback on lessons and support with planning and managing core elements of effective thinking lessons. This is taken into consideration in the third study presented in this thesis.

1.6 Outline of this Thesis

This chapter has shown that there is a prevalent view in education that in learning environments the focus should no longer primarily be on transmitting knowledge. National initiatives and curriculum policies are developing in response to this demand and the teaching of thinking skills is emphasised in many schools. The difficulties facing practitioners trying to integrate initiatives such as thinking skills into teaching methodologies have been discussed. Links have to be made between what is happening in practice as a result of the 5 – 14 curriculum and related policies, with what is being promoted now. Contemporary national priorities and *A Curriculum for Excellence* must be viewed as vehicles through which current practice can be enhanced and built upon.

The move to develop effective thinking explicitly within the curriculum is one whose success will be dependent on educational theorists, policy makers, practitioners and learners recognising the core attributes involved in fostering effective thinking. A number of frameworks were analysed in this chapter in terms of types of thinking covered, individual skills promoted, and whether they included aspects relating to dispositions and motivation. Common types of thinking, such as metacognition,

critical and creative thinking, information processing skills, decision making and problem solving strategies were highlighted. However, there is a need to examine what ‘good thinking’ means to practitioners and children (e.g., are the cognitive processes underlying particular thinking skills understood? Is the positive correlation between improving thinking skills and improving intelligence recognised?), and the extent to which opportunities are currently provided to foster this ability. When encouraging practitioners to teach thinking skills, an important first step is surely to ascertain which thinking skills are currently being taught throughout primary school.

This chapter has highlighted the implicit connection at the theoretical level between developing ‘intelligence’ and ‘effective’ thinking. The following chapter analyses teachers’ and pupils’ concepts of these two phenomena. It will also highlight the dearth of research on concepts of effective thinking compared to the amount of research on concepts of intelligence. Chapter 3 will discuss different approaches currently circulating in education through which, it is claimed, effective thinking can be developed. The contrast will be made between packages teaching thinking skills as a discrete subject, and the infusion method that strives to integrate opportunities for effective thinking throughout all curricular areas. The underpinning pedagogy of infusion lessons will be discussed in-depth (i.e., teaching skills explicitly, fostering thinking dispositions, developing metacognition, encouraging transfer and the benefits of collaborative learning).

On the basis of this literature review, the first empirical study reported thereafter (Chapter 4) explores teachers’ concepts of effective thinking and their views of the advantages of collaborative learning. It also presents teachers’ perceptions of the integration of thinking skills into the 5 – 14 curriculum (which skills are currently being taught and in which curricular areas) and whether there is a coherent progression of skills being taught from early years to upper primary. Study 2 (Chapter 5) analyses children’s conceptions of effective thinking and intelligence from a developmental perspective and with regard to uncovering definitions, characteristics and causes associated with each. In addition to investigating the

correlation between children's views of these two concepts, it will also identify age-trends in children's understanding of individual thinking skills.

Following this, the final study in this thesis examines in more detail the effects of an intervention designed to enhance primary seven pupils' thinking skills. This study draws on the fundamental aspects of infusing effective thinking (highlighted in the introductory chapter) into curricular lessons. It also attempts to challenge teachers' and pupils' conceptions identified in Chapters 4 and 5. In contrast to the first two studies, Study 3 will be reported over two chapters. Chapter 6 will provide detail on the creation of the intervention study, the materials used and the close training network that was established with the teachers involved. Chapter 7 presents the in-depth research-oriented evaluation of the intervention, designed to measure the effect of teaching thinking skills explicitly and the benefits of collaborative learning.

A general discussion of the findings from all three studies will be presented in Chapter 8. This chapter will contextualise and draw together the findings from all three studies by relating them to the literature reviews presented in the first three chapters of this thesis. Implications will be discussed with regard to policy and practice in education.

CHAPTER 2

CHILDREN'S and TEACHERS' CONCEPTS OF THINKING SKILLS and INTELLIGENCE

2.1 Aims of this Chapter

Chapter 1 outlined key characteristics relating to children's thinking skills. It also argued that the intention to create children capable of independent and effective thinking is not an aim specific to 21st century education. However, previous policy documents and curricular guidelines have not promoted core thinking attributes explicitly. The explicit teaching of thinking skills is something which many theorists feel is central to the potential success of the 'thinking skills' initiative (Beyer, 1987, 1997; Costa, 2001; Fisher, 1990; McGuinness, 1999). Central to these accounts is the claim that children can be taught skills to help them think more effectively. Chapter 1 also identified broad types of thinking operations identified by many researchers that should be cultivated (e.g. Bloom, 1956; Ennis, 1987; Halpern, 1997; McGuinness, 2000a, 2003; Paul, 1993; Swartz & Parks, 1994). Furthermore, an exploration of theorists' definitions of effective thinking revealed thinking skills as influential components of intelligence.

This chapter will consider relevant literature with the aim of uncovering children's baseline concepts of intelligence and effective thinking. It will be shown that whilst there is substantial research on children's concepts of intelligence, very little exists on children's concepts of thinking skills. Teachers' views of effective thinking and intelligence will also be discussed, with particular reference to research which suggests that teachers' concepts are transmitted to learners through their daily classroom practices. The implications of these research findings will be contextualised with regard to the empirical studies in this thesis. Specifically, it will

become evident that more research is needed on children's and teachers' concepts of effective thinking and their understandings of individual thinking skills.

2.2 Introduction

In Chapter 1 it was argued that experts' definitions of intelligence commonly encompass specific thinking abilities. In recent years children's conceptions of the nature of intelligence have been researched with increasing interest. For example, in 1985 Yussen and Kane interviewed children with a view to deepening understanding of children's developmental concepts of intelligence (including their definitions, characteristics and causes of intelligence). Recently, Kurtz-Costes, McCall, Kinlaw et al. (2005) analysed age-trends and cross-cultural comparisons in data obtained from USA and German children's conceptions of intelligence. However, despite the inherent link between intelligence and effective thinking, and despite increasing interest in establishing children's concepts of intelligence, few studies have attempted to gather explicitly data on children's concepts of effective thinking. Similarly, adults' conceptions of intelligence have recently been investigated with increasing interest (e.g., Sternberg, 2000; 2004; Sternberg & Detterman, 1986). However, little research exists to explore how specifically teachers view intelligence, their concepts of effective thinking and their beliefs about the extent to which thinking skills are integrated into the curriculum. This is surprising as teachers are often central to the success of educational interventions, and teachers' understandings have been shown to influence children's views. It is important, therefore, to establish how teachers and children view effective thinking and intelligence as it is these conceptions that may affect children's attitudes, dispositions, motivation and confidence, and indirectly affect ability (Dweck, 1999).

2.3 Children's Concepts of Thinking Skills and Intelligence

2.3.1 Concepts of Thinking Skills

Minimal research exists that contributes to our understanding of how pupils conceive of the term 'good thinking'. In a similar vein, children's concepts are under-researched with regard to the characteristics associated with effective thinking and

the factors identified as being causes for being able to think effectively. When so many programmes in education seek to develop this ability in pupils (see Chapter 3 for an overview of approaches), it seems important that pupils' knowledge of the elements involved in effective thinking are uncovered, before attempting to intervene and build on baseline knowledge.

In Chapter 1, a scrutiny of policy documents promoted recently in Scotland revealed that opportunities have been provided in recent decades to develop children's ability to think. However, *A Curriculum for Excellence* intends to formally and explicitly develop children's thinking skills, something which the 5 – 14 curriculum did not fully accomplish. With thinking skills being promoted as a priority within educational environments, it is important that children's current understanding of thinking skills is identified. It is important that this baseline measure is established so that children's concepts and knowledge of thinking skills as a result of the implementation of the 5 – 14 guidelines can be measured. Similarly, the impact of *A Curriculum for Excellence* on children's thinking skills will be difficult to monitor without gathering baseline data on children's concepts of effective thinking and understandings of individual thinking skills.

It is also of value to discover how children's concepts may change throughout primary school. Identifying how children's views of thinking skills change with age will be particularly relevant when seeking to intervene to develop children's concepts and target specific thinking skills at particular ages. Study 2 in this thesis will therefore provide novel developmental data on children's conceptions of effective thinking and their understandings of some of the most common thinking skills. Findings from Study 2 will be used to inform the creation of the intervention study presented in Chapters 6 and 7.

Although very little research exists on children's understanding of thinking skills, several things can be deduced from the literature on children's concepts of intelligence that might be relevant for the purposes of the empirical studies in this thesis. This research is crucial to establish a baseline of children's concepts before

attempting to intervene to challenge these concepts and enhance concepts of intelligence and effective thinking.

2.3.2 Concepts of Intelligence

An analysis of the prominent research articles within the field of intelligence highlights key themes that have been investigated historically in connection with children's concepts of intelligence. For example, in one of the first studies of its kind, Yussen and Kane (1985) interviewed 71 children from three different age groups to discover their conceptions regarding: the visible signs of intelligence, qualities associated with intelligence, the influence of nature and nurture on intelligence, the constancy of intelligence, a general definition of intelligence, and an assessment of their own "relative intelligence". These issues remain prominent within the field of research on intelligence. Kinlaw and Kurtz-Costes (2003) recently wrote a summary review of research in this area, and categorised literature under broad headings such as children's understandings of the nature of intelligence and the malleability of intelligence. In a similar vein to the Yussen and Kane study, although they used a larger sample size and included a cross-cultural comparison, Kurtz-Costes et al. (2005) researched children's developmental conceptions regarding four of these key issues; definitions of intelligence; characteristics of intelligence; the malleability of ability; and the relationship between effort and ability. For this thesis and for researching children's concepts of intelligence, data will be critically reviewed on these prominent themes of research.

Children's Concepts of the Definitions, Characteristics and Causes of Intelligence

Many studies suggest a developmental trend in the way children define and describe the signs of intelligence (e.g. Cain & Dweck, 1995; Kurtz-Costes et al., 2005; Stipek & MacIver, 1989; Yussen & Kane, 1985). Some have found that younger children tend to associate intelligence with increasingly developed social skills and non-cognitive abilities, such as likeability, being nice and being polite (e.g. Heyman, Gee & Giles, 2003; Kurtz-Costes et al., 2005; Stipek & Tannatt, 1984). By contrast, typical analyses of older children's perceptions have found that, with age, children are increasingly likely to associate intelligence with increased cognitive ability and

by how much knowledge one has (Kurtz-Costes et al., 2005; Yussen & Kane, 1985). In this respect, these findings provide a link to Chapter 1 where it was discussed that, traditionally, one of the primary aims of teachers has been to impart knowledge to children, a situation which has been exacerbated by the curricular guidelines and policies emphasising vast amounts of content. It is perhaps not surprising that a consequence of this focus is that children view knowledge-acquisition as a principal aim of their schooling. As Kinlaw and Kurtz-Costes state in their summary paper of research within this domain:

Direct inquiries to children about the definition of “smart” or “smart in school” have shown consistently that children recognise that smartness is linked primarily to knowledge or other cognitive/intellectual abilities.

(2003, p. 129)

Furthermore, the majority of research conducted within this area has shown that children’s views about the *characteristics* of intelligence suggest that younger children also tend to hold non-cognitive views about the signs of intelligence, citing for example social traits such as being nice and helpful. In contrast, findings indicate that older children believe ‘cleverness’ is evidenced more through an increased cognitive and internalised ability (Droege & Stipek, 1993; Kinlaw & Kurtz-Costes, 2003; Yussen & Kane, 1985).

These findings imply that by the time children reach secondary school, the majority of pupils associate ‘cleverness’ with general cognitive abilities or knowledge in particular. It would seem a valid aim of interventions, therefore, to ensure that teachers raise children’s awareness that ‘being clever’ is not simply a matter of acquiring and memorising facts; that intelligence is more concerned with utilising thinking skills, strategies and dispositions. Regardless of age, children tend not to associate ‘cleverness’ with the application of thinking skills. Studies 2 and 3 in this thesis will determine if children conceptualise effective thinking in a similar way. Furthermore, Study 3 will analyse the effect of a thinking skills intervention on children’s concepts of effective thinking and intelligence.

Stability of Intelligence

Although it is not yet agreed what intelligence is, theories abound regarding its stability. Until recently, it was widely accepted that intelligence was a fixed capacity, something which an individual was genetically prescribed. Now it is increasingly accepted to view intelligence as something which can be cultivated through experience and learning (e.g., Dweck, 1999; Sternberg & Bhana, 1996; Sternberg, 1999, 2000). Some of the most influential research on children's concepts of the stability of intelligence has been conducted by Dweck (Cain & Dweck, 1995; Dweck, 1999). Dweck & Bempechat (1983) proposed that children's beliefs about intelligence fall into two main categories; entity theories (intelligence is fixed) and incremental theories (intelligence is malleable). Dweck has constructed various tests to measure whether a child believes intelligence to be fixed or malleable by asking them to show the extent to which they agree with statements such as, "You have a certain amount of intelligence, and you really can't do much to change it" and "No matter how much intelligence you have, you can always change it quite a bit" (Dweck, 1999). Dweck instigated various studies using these tests, and summarised:

...entity theorists' concerns about looking smart can prevent them from seeking learning opportunities, even ones that could be critical to performing well in the future.

(1999, p. 23)

Regarding children's perceptions of the stability of intelligence, the literature reviewed highlights mixed and inconsistent findings in connection with age-related trends. For example, Yussen and Kane's research (1985) indicated that the majority of children at all ages believe that change in intellectual ability is possible, but that younger children were more convinced about the possibilities of a person changing from 'dull' to 'bright', and much less likely that a person could change from 'bright to dull'. However, many theorists have found evidence to suggest that young children are less likely to view ability as a stable trait (e.g., Dweck & Bempechat, 1983; Stipek & Daniels, 1988; Stipek & MacIver, 1989). For example, Kurtz-Costes et al. (2005) reported findings suggesting that, whereas younger children believed that intelligence is malleable, older children tended to hold fixed trait views of

intelligence, a finding which they suggest could be as a result of the educational systems in place. Kinlaw et al (2003) imply that in general, there is a shift in children's understanding of the malleability of intelligence between the ages of 7 and 9 years of age, with older children tending to believe in the temporal constancy of intelligence.

Understanding children's beliefs about the extent to which intelligence can be modified is an important first step for any educational intervention attempting to enhance intelligence and effective thinking. If children believe intellectual capacity is fixed, there is less chance of them realising that thinking skills can be employed to increase their performance on challenging tasks. Similarly, if children view intelligence as malleable, there is a greater chance that they will be willing to utilise various thinking skills, strategies and dispositions, and be more likely to persevere when faced with difficulties. For this reason, an important baseline assessment conducted prior to the educational intervention in Study 3 is the measurement of children's (and teachers') views about the stability of intelligence.

Effort and Ability

In addition to devising a way of determining whether a learner holds an entity or incremental view of intelligence, Dweck has also conducted subsequent tests to determine how this is likely to make them respond when faced with challenges (e.g., whether they will display 'Helpless' or 'Mastery-Oriented' responses) (Cain & Dweck, 1995). She believes that children's theories of intelligence, and whether they are likely to respond in a 'helpless' way or a 'mastery-oriented' way, dictates the type of goal a learner may have; whether that is a 'performance' goal or a 'learning goal' (Dweck, 1990 and Dweck & Elliot, 1983 in Dweck, 1999; Elliot & Dweck, 1988). As the term may suggest, a child with a 'performance' achievement goal will be concerned with getting the task correct and 'looking' clever. In contrast, a child with a 'learning' goal will have the main priority of learning new knowledge, skills and dispositions; learning goals cultivate the thirst for learning. These self-theories are to an extent self-fulfilling prophecies, since if a child predicts they may be unable

to do something, that will affect their effort, motivation and confidence and consequently their actual achievement.

In general, the majority of theorists believe that younger children associate increased ability with increased effort, whereas older children perceive an inverse relationship between these two elements, stating that higher effort implies lesser ability. As Kurtz-Costes et al. found, “Specifically, the younger children thought smart people work hard, and that people who are not smart do not work hard” (2005, p. 227). Heyman et al’s (2003) findings were consistent with this as they found that children in pre-school tended to associate high effort with high academic ability. Similarly, in a study conducted by Droege & Stipek (1993), they found that as a child develops they become decreasingly likely to believe that academic competence can be enhanced through effort. Covington (1983) and Kurtz-Costes et al. (2005) concur with this and also consider there is an inverse relationship between ability and effort the older the child gets, with the majority of children of this age group believing that less able children work harder than their more able peers. Similarly, Meece (1994) thinks that many children come to adopt the belief that increased effort implies lower ability, specifically those children holding ‘performance goals’.

These findings regarding the relationship between effort and ability also have important implications for interventions seeking to develop intellectual and thinking abilities. This research indicates that, with age, many children are less likely to believe that effort will increase their cognitive capacities. For this reason, it is important that classroom interventions designed to foster cognitive abilities simultaneously highlight the important role effort and perseverance have to play. Study 2 in this thesis gathers data on how Scottish children’s views of effort and ability change over time. Study 3 involves an intervention designed to ensure that children’s concepts of effort and ability are deepened with regard to enhancing thinking ability through specific cognitive processes and appropriate thinking dispositions (such as ‘having a go’, and ‘persevering’).

Summary of Children's Concepts

In line with recent national initiatives (discussed in Chapter 1), research on children's concepts of effective thinking, and their understandings of individual thinking skills is now clearly warranted. These will be investigated in Studies 2 and 3 in this thesis. The majority of research highlights the presence of developmental trends in children's understandings of intelligence. Comparative developmental data is also needed to determine if age trends exist in children's understandings of effective thinking. Chapter 1 highlighted the link between developing intelligence and fostering thinking skills. Future research is required to determine if there is a connection between children's views of effective thinking and intelligence, something which will be investigated in Study 2. Furthermore, children's views of the stability of intelligence and their beliefs about the relationship between effort and ability is one which needs further attention. In regard to this and based on findings from Study 2 in this thesis, the intervention study presented in Chapters 6 and 7 will explore the impact of deepening these concepts through an explicit thinking skills intervention.

2.4 Teachers' Concepts of Thinking Skills and Intelligence

2.4.1 Concepts of Thinking Skills

Teachers' concepts of effective thinking and thinking skills are also relatively under-researched. It is evident that there are similarities between many of the theoretical definitions of effective thinking (discussed in Chapter 1), and there is general agreement between many theorists about the individual skills involved within each of the main thinking types. However, as the thinking skills initiative is a relatively new development within education, it is not surprising to find little published research to determine how practitioners and learners understand effective thinking. In schools, teachers frequently urge pupils to 'think harder', and praise 'good thinking' (Beyer, 1988; Pithers & Soden, 2000), but there is little evidence to suggest that teachers and children understand the processes involved within the vague term 'thinking'. For example, it is not known how teachers perceive 'effective thinking', whether they have a solid knowledge of the individual skills within the main categories of critical

and creative thinking, and whether they provide opportunities for learners to practise the stages involved in making careful decisions and solving problems skilfully. Furthermore, little data exists to demonstrate whether practitioners understand the importance of building on children's existing knowledge of thinking skills ensuring all learners are exposed to a coherent progression of thinking skills, and whether this understanding is evidenced in daily classroom practices. Zohar, Degani and Vaaknin (2001, p. 469) argue:

As the drive for teaching for understanding and higher order thinking gains momentum in our schools, there is a pressing need for deeper investigation into the conditions necessary for its success. Since teachers' knowledge and beliefs are crucial factors in determining the effect of any educational endeavour, it is important to study them in the context of teaching thinking.

Regarding the investigation into teachers' concepts of the broad term 'effective thinking', little research exists. One exception comes from an American study which attempted to analyse university lecturers' concepts of 'critical thinking' (Paul, Elder, & Bartell, 2004). Paul et. al found that, out of 140 lecturers' interviews, only a small percentage (19%) could reasonably define critical thinking, although the majority of lecturers (89%) stated it as being one of the main goals of their teaching. In terms of reconciling the demands of teaching content knowledge with developing effective thinking, again, the majority of lecturers surveyed (77%) had 'limited or no conception' of how to enhance critical thinking through subject content.

Although there is a dearth of research into teachers' baseline concepts of 'effective thinking, an area which has recently been given more attention is the extent to which practitioners foster higher order skills with learners of different abilities. In 1987, Resnick argued that higher order thinking skills should not only be taught to higher achieving learners. However, more recently, Torff (2005), Warburton and Torff (2005) and Zohar, Degani and Vaaknin (2001), have provided some research which suggests that teachers believe it is more appropriate to teach 'high-achieving learners' high critical thinking activities (i.e., higher order thinking skills), and 'low-achieving learners' more basic low critical thinking activities skills. They define

high critical thinking activities as incorporating more child-centred thinking skills, and low critical thinking activities as being centred on transmission teacher-led activities. One recent study conducted by Warburton and Torff involved 145 secondary school teachers. They claimed that their findings support results in similar studies that, “teachers judged high-CT activities to be more effective with high-advantage learners than low-advantage ones” (2005, p. 28). They perceive the problem created from this finding to be that all learners should have equal opportunity to access higher-order thinking skills instruction:

...high-advantage learners receive high-CT (critical thinking) instruction that results in high-level academic performance that, in turn, makes still more high-CT lessons likely; but low-advantage learners receive few high-CT lessons, making them less likely to develop sufficiently strong academic skills to be deemed ready for high-CT instruction in subsequent lessons.

(2005, p. 25)

Zohar et al. agree that this results in self-fulfilling prophecies for the learners (2001). In their interview-based study of 40 teachers, they discovered that 45% of the teachers believed that the incorporation of knowledge-acquisition tasks was more appropriate for the low-achieving learners (p. 482). They also noted the lack of impact made by many teacher-training programs on teachers’ beliefs about fostering thinking skills. As a result of their findings, Zohar et al. warn that (p. 483):

...it makes sense to assume that the initial ideas of many teachers regarding LA (low-achieving) students and instruction of higher order thinking may hinder successful implementation of programs designed to teach thinking.

These findings have obvious implications for the empirical studies conducted in this thesis. It is evident that there is little research that is directly relevant to furthering understanding of teachers’ concepts of effective thinking. Other recent studies reported in this section have tended to explore the extent to which practitioners teach what they perceive to be ability-specific thinking skills. A primary aim of this thesis, however, is to identify teachers’ baseline concepts of effective thinking, and the extent to which thinking skills are taught within whole-class curricular lessons in

Scotland. Study 1, presented in Chapter 4, seeks to provide new data on this. These concepts will be uncovered with a view to providing a context for understanding children's concepts and then designing a thinking skills intervention study. Whilst of interest for this study, exploring the extent to which teachers' beliefs are targeted at particular achievement groups is outwith the scope of this thesis.

2.4.2 Concepts of Intelligence

Identifying teachers' concepts of intelligence is important because, as is discussed later below, they are shown to influence children's. Detecting these concepts is therefore an important precursor to devising an accurate and targeted staff development training programme to challenge them. However, similar to research on teachers' concepts of effective thinking, relatively little research has been conducted to establish teachers' concepts of intelligence. Of relevance for this thesis, however, is Sternberg's work which seeks to develop our understanding of adult conceptions of intelligence in general (e.g., Sternberg, Conway, Ketron et al. 1981). Although his findings are extensive and impact on much of the other research conducted in the area, some of his most significant findings revolve around how conceptions of intelligence differ depending on the cultural context in which they are found. He notes that many Western notions about what constitutes intelligent behaviour, are not shared by other cultures, a finding which is reinforced by other researchers (Shi, 2004; Sternberg, 2004). Many of these conceptions of intelligence are dictated by the tests used to evaluate intelligence in those cultures (Rosas, 2004; Sternberg, 2004); intelligence is what intelligence tests measure (e.g., Sternberg, 1987a). Within cultures, conceptions of intelligence are also heavily influenced by tradition within society. For instance, in China, effort and diligence are seen as being the most crucial aspects of intelligence (Shi, 2004). Yet Gill & Keats (Gill & Keats, 1980, in Sternberg, 2000) noted that in a study conducted with Australian university students, greater importance was placed on academic skills as compared to Malay students who rated practical skills as being as important as verbal and creative skills. In African and Asian cultures many researchers have found there to be a greater emphasis on social skills within conceptions of intelligence (Lim, Plucker, & Kyuhyeok, 2002; Sternberg, 2000). One notable study (consisting of a

series of experiments) conducted by Sternberg, Conway, Ketron and Bernstein (1981) involved identifying laypersons' concepts of intelligence. In one experiment all 186 respondents were asked to cite various behaviours relating to one of four categories (i.e., "intelligence", "academic intelligence", "everyday intelligence" and "unintelligence"). They concluded that:

In particular, people seem to have at least somewhat different conceptions of the meanings of intelligence, academic intelligence, and everyday intelligence, and these conceptions may differ across populations of subjects.

(1981, p. 42)

In a further experiment they compared laypersons' concepts of intelligence with experts' conceptions. They discovered many similarities between the factors underlying the laypersons' concepts of intelligence (which were categorised into practical problem-solving ability, verbal ability and social competence), and those of experts (i.e., verbal intelligence, problem-solving ability and practical intelligence).

Although the majority of research has focused on adults' concepts in general, there has been some research that has specifically explored teachers' concepts of intelligence. For example, Fry (1984) conducted one large-scale study to investigate the behaviours teachers associate with 'intelligent functioning'. The first phase of his study involved gathering data on 249 teachers' concepts from three groups; primary, secondary and tertiary (e.g., community colleges) schools. The analyses categorised teachers' concepts of intelligence in relation to three main factors; cognitive (e.g., "reasons well", "makes good decisions", "shows creativity"); verbal (e.g., "speaks clearly", "has a good conversational ability, is interesting", "reads widely"); and social (e.g., "is sensitive to other's needs", "respects law and order", "is helpful"). Findings indicated that primary (i.e., 'elementary') teachers, were more likely than secondary and tertiary teachers to include social and verbal factors within their concepts of intelligence. Furthermore, tertiary teachers tended to include cognitive behaviours more than the other two groups as being indicative of intelligent functioning. Fry believes that perhaps the most important implication from this research is that, at different stages of schooling, teachers may be

emphasising quite varied skills, aptitudes and values. This finding provides further evidence of the need to establish how teachers view intelligence.

In general, the goal of exploring teachers' concepts of intelligence has primarily been conducted with a view to establishing how teachers' views affect children's concepts. Many theorists believe that teachers' concepts of intelligence will (albeit subconsciously) be apparent in his/her actions, teaching style, feedback and assessment to children and evident through social interactions with the children (Dweck, 1999; Nespor, 1987; Pretzlik, Olsson, Nabuco et al., 2003; Stipek, 1981). Classroom ethos and practice can often be founded on a teacher's implicit views of intelligence. As Nespor notes, "It can certainly be argued that teachers' beliefs play a major role in defining teaching tasks and organising the knowledge and information relevant to those tasks" (1987, p. 324). Similarly, Pajares states:

Researchers have demonstrated that beliefs influence knowledge acquisition and interpretation, task definition and selection, interpretation of course content, and comprehension monitoring.

(1992, p. 328)

Perhaps of most relevance for this thesis, is Sternberg, Conway, Ketron et al.'s finding that, "People use their implicit theories of intelligence in evaluating the intelligence of others as well as of themselves" (1981, p. 53). It is important therefore to take account of these factors before attempting to design classroom interventions, such as the one presented in Chapters 6 and 7 of this thesis. In this way, teachers' knowledge of their own concepts of intelligence (and the effect these can have on children's beliefs) can be deepened, and targeted through relevant staff development.

In the previous section, Dweck & Bempechat's (1983) work on children's entity theories (intelligence is fixed) and incremental theories (intelligence is malleable) was discussed. Dweck (1999) also argues that teachers' theories of intelligence can also be classified as either entity or incremental. This implication of this is that, if teachers are shown to have entity views of intelligence, training them to teach

thinking skills and dispositions is likely to be futile as they would not have an understanding that cognitive processes enhance capacity for intelligent thought. Dweck & Bempechat (1983) believe that teachers holding entity views of intelligence employ teaching strategies that “flow intuitively” from that theory, and likewise for teachers with incremental views. For instance, teachers with an entity theory are likely to give children relatively easy tasks with a high chance of success and low chance of failure, thereby letting each child feel intelligent. Teachers holding an incremental view of intelligence would see the main aim not as each child achieving success on easy tasks, but that each child is stretched and engaged in challenging thinking tasks where the processes of learning and thinking are given as much importance as the end product of the task. Dweck & Bempechat therefore cite classroom practice as being the main vehicle through which teacher’s views about children’s intelligence is transmitted.

Based on Dweck and Bempechat’s (1983) belief that teachers’ concepts can be categorised as similar to those of children’s (i.e., either entity or incremental), Lynott and Woolfolk (1994) sought to gather more data on teachers’ beliefs about intelligence, as they recognised it as being under-researched within the larger domain of adults’ and experts’ concepts of intelligence. They also aimed to gather comparative data on Sternberg et al.’s 1981 study mentioned above. Through a variety of studies involving a sample of roughly 700 teachers, they concluded that, “teachers may have implicit theories of intelligence that differ slightly from those of the general population” (p. 255). Three main dimensions were identified in teachers’ beliefs about intelligence; practical/academic intelligence (e.g., “good study habits”, “good reading, speaking and writing skills”, “knowledge of world affairs & other aspects of life”); conceptual thinking (e.g., “reasoning skills”, “problem solving ability”, “abstract thinking”); and social adaptiveness (e.g., “ability to adapt”, “sensible”, “able to interact well with different types of people”). Although they identified a slight trend for teachers to hold incremental theories of intelligence, respondents’ beliefs varied widely. This finding also implies that, since teachers conceptualise intelligence in different ways, and since these beliefs influence learners

through their classroom practices, these need to be identified. This will be addressed within Study 3 of this thesis.

Pretzlik, Olsson and Nabuco et al (2003) studied teachers' folk theories of intelligence, with specific reference to how these theories affect children's 'self-perception as learners'. Findings highlighted a similarity between teachers' views of intelligence with children's general IQ ability. Furthermore, pupils' own views of their ability significantly correlated with the teachers'. Pretzlik et al discuss various reasons for this but single out the importance of classroom feedback in transmitting the teachers' implicit theories to the children and so contributing to the children's self-perceptions as learners. In many ways these findings are concerning as it could suggest that teachers believe intelligence is that which is measured by traditional IQ tests. If this is the case then teachers are not aware of or considering how important a learner's potential is in determining how they will perform on tasks in the future with appropriate support and cultivation of, for example, thinking skills, strategies and dispositions. Furthermore, this is also a cause for concern as teachers' views about the varying levels of individual children's intelligence has an impact on learners' own views about themselves. This has been widely discussed (e.g., Hart, Dixon, Drummond et al., 2004), with many theorists now arguing that the notion of general ability is not a useful concept for teachers, particularly as it does not take into account a child's potential. As Hart et al argue:

When young people's learning is dominated by judgements of ability, their sense of identity may be profoundly affected, not just while they are at school, but beyond, into adulthood.

(2004, p. 4)

Stipek (1981) also reported a significant correlation when comparing children's perceived competence levels with the teacher's ranking of each child. Teacher feedback was seen as being instrumental in developing children's opinions of self-competence. These findings are congruent with Stipek & Tannatt's (1984) study of 4 – 8 year olds, where, using an open-ended interview the children were asked to rate their classmate's ability alongside their own, and explain in terms of smartness. The

children's ratings of their own and their classmate's ability were seen to correlate positively with the teacher's rankings of ability.

Kamins and Dweck (1999) discovered similar findings through a series of experiments. They found that the feedback that children receive, for instance praise or criticism, is paramount in developing either 'mastery-oriented' (persevering when faced with failure) or 'helpless' (perceiving situations to be outwith their control) responses in children. Their goal was to see whether the feedback given on the task would affect the children's response when encountering future difficult tasks. Structured experiments were devised where, after children had carried out set tasks, they were either given praise or criticism directly relating to their performance on that task. In short, they discovered that the type of feedback children received (either from parents or teachers) did make a difference in instilling in children either helpless or mastery-oriented patterns. However, they also found that it was more complex than merely distinguishing between praise and criticism. To create mastery-oriented responses, praise had to be given to the children's effort and use of appropriate strategies ("You really tried hard"), rather than praise for individual children ("You're a good boy/girl").

Rosenholtz & Rosenholtz (1981) reinforce the point that the teacher is a key influencing factor on learners' self perceptions, or a child's 'self-evaluation of ability'. However, rather than singling out teacher feedback as the predominant means through which teachers' implicit theories of intelligence are transmitted and consequently affect learners' self-perceptions, they believe that it is through teachers' daily classroom practices in general that children's self-perceptions are influenced. They identify the salience of four strands (task differentiation, autonomy, grouping and assessment) as effecting learner and teacher conceptions of ability.

Perhaps of most relevance for the intervention study presented in this thesis, is the belief held by many theorists that, through intervention, concepts of intelligence can be changed. As Dweck concludes (1999, p. 24):

...people's theories of intelligence are malleable...Students may arrive in our experiments with strong and long-standing beliefs, but we can, at least temporarily, tune them into a different one.

Furthermore, as Daniels and Shumow note (2003, p. 504):

Considering the extensive research on how views of intelligence affect achievement-related behaviour... it is surprising that more studies have not examined how such views change with experience and education.

It is therefore important that classroom interventions establish what these views might be before attempting to place any significance on children's conceptions, possible causes of them and attempt to challenge them where necessary.

Summary of Teachers' Concepts

Whilst highlighting the current interest in determining practitioners' teaching of ability-specific thinking skills, the lack of research on how teachers perceive the phenomenon of 'effective thinking' is evident. Considering the current focus within education to ensure teachers are fostering children's effective thinking, this needs to be addressed. This section has also discussed the relatively large amount of research on adults' concepts of intelligence, yet found few studies within the field have concentrated specifically on determining teachers' concepts of intelligence. This section has shown the importance of gathering information on teachers' concepts of intelligence as teachers' beliefs have been shown to be transmitted through their classroom practices. This is widely accepted to impact on a child's engagement with tasks and motivation. Research also indicates that it will determine whether a child will persevere when challenged and enjoy difficult tasks, or whether they will respond best to easier achievement-based assignments. Whilst the focus for these beliefs has centred around transmitting theories of intelligence, an interesting area for investigation would be whether teachers' beliefs about effective thinking are conveyed in a similar way.

These findings have implications for the third study in this thesis. As teachers' concepts influence children's, it is important that these are established before asking

teachers to participate in an intervention study seeking to deepen children's concepts. Furthermore, as general classroom practices have been shown to affect learners' concepts and motivation, this could suggest that educational interventions would be more successful when enhancing teachers' methodology (which would include assessment, feedback, groupings, and task content), rather than encouraging them to teach a discrete resource in isolated lessons each week. Chapter 3 will therefore discuss a variety of thinking skills interventions and make the distinction between thinking skills taught discretely, and those interventions designed to target pedagogy in general. Furthermore, it will be highlighted that the majority of thinking skills interventions do not take account of teachers' and pupils' concepts of effective thinking and intelligence.

To ensure that the potential of the thinking skills initiative is realised within curricular areas, teachers' understandings of what it means to be an effective thinker must be identified. This would enable baseline data to be gathered on which thinking skills are currently being taught (if any), at which stage and in which curricular subjects. This area for research is the focus for Study 1 in this thesis (see Chapter 4). Furthermore, before the implementation of the thinking skills intervention presented in Study 3, it is important to discover whether teachers hold entity or incremental views of intelligence. Only then can targeted appropriate materials and staff development training enhance current good practice, rather than being an unsustainable 'quick-fix'.

2.5 Conclusions and Implications for this Thesis

The findings surveyed in the above sections of this chapter have clear implications for the empirical studies in this thesis. Firstly, when so many educational interventions seek to develop children's thinking skills, it is surprising that such little research has been conducted to examine children's and teachers' concepts of what it means to be a 'good thinker'. Furthermore, teachers' and pupils' knowledge of individual thinking skill processes is not known. Secondly, at the theoretical level, it is becoming increasingly popular to view intelligence as malleable through a variety of different approaches. However, the message to children in schools (that it is

within their ability to become more intelligent and competent) is perhaps not clear. These findings suggest that more work needs to be conducted with practitioners to ensure the association between developing effective thinking (including skills, dispositions, and effort) and becoming more intelligent is made explicit. Finally, a variety of research exists on children's concepts of intelligence and the ways in which teacher beliefs influence children's. These findings have relevance for thinking skills interventions. For example, teachers need to be made aware of the importance of being cautious about transmitting their own concepts of intelligence through classroom practices and being sensitive about reinforcing the stereotypical view of intelligence as equalling knowledge acquisition. Devising in-depth teacher training is therefore an important measure to ensuring successful educational interventions, both to explore teachers' concepts and to ensure practitioners are aware of how their beliefs can affect children's self-beliefs. If the above arguments are sound, then the policy implication is that teachers need to be encouraged to reflect incremental theories of intelligence through their daily classroom practices. Similarly, practitioners need to promote the positive correlation between persevering on challenging tasks with increased ability.

The following chapter will discuss key features of various interventions designed to enhance thinking skills, and analyse available research in support of each. It will also contrast interventions which teach thinking through isolated lessons with the infusion approach, which represents a more holistic way of fostering effective thinking throughout the curricular areas. These approaches will be examined in relation to the intervention study presented in Chapters 6 and 7 of this thesis. This chapter has highlighted the lack of research into teachers' concepts of effective thinking and their beliefs about the frequency with which thinking skills are infused throughout the curricular areas. Study 1, reported in Chapter 4, investigates teachers' concepts of thinking skills. It has also been shown in this chapter that, whilst various studies have analysed children's concepts of intelligence in relation to the key issues (i.e., definitions and characteristics of intelligence, stability of intelligence and the association between effort and ability), few (if any) have specifically researched children's understandings of effective thinking. Chapter 5 (which reports on Study

2) brings together data to uncover children's definitions of effective thinking, the characteristics and the causes they associate with the phenomenon. In addition, Chapter 5 examines children's knowledge of five of the most common types of thinking skills, something which this chapter also highlighted as being under-researched. Chapters 6 and 7 (reporting Study 3, the intervention study of this thesis), will take into account the issues raised in this chapter by gathering baseline data on both teachers' and children's concepts of effective thinking and intelligence before providing in-depth training to teachers involved with the intervention study.

CHAPTER 3

PUTTING THEORY INTO PRACTICE: AN EVALUATION OF APPROACHES DESIGNED TO DEVELOP EFFECTIVE THINKING

3.1 Aims of this Chapter

Chapter 1 detailed core types of thinking skills that are present within many theorists' definitions and frameworks for effective thinking. Chapter 2, however, found little research on teachers' and children's concepts of what it means to be an effective thinker. It also presented the belief held by many theorists that teachers' concepts impact on children's beliefs through their classroom practices. The central aim of this chapter is therefore to investigate some of the most prominent thinking skills approaches incorporated into practitioners' practice. These programmes are designed to enhance children's thinking skills and will be discussed from both a research and a pedagogical perspective. Particular attention will be paid to the underpinning pedagogy of the infusion approach and the benefits of incorporating opportunities for collaborative learning within thinking skills lessons. These will be discussed in relation to the final intervention study presented in this thesis, which aimed to evaluate the impact of infusing thinking skills throughout the curriculum, and test the advantages of collaborative as opposed to individual learning.

3.1.1 Different Ways to Teach Thinking Skills

As discussed in Chapter 1, the explicit teaching of thinking skills in schools has risen to the forefront of educational aims. Whilst many practitioners maintain that they have always implicitly taught children how to think, the purpose of many of the thinking skills programmes is to teach for thinking explicitly (e.g., Beyer, 1988; Costa, 2001; Perkins, 1992; Swartz, 1987; Swartz & Parks, 1994; Tishman, Perkins,

& Jay, 1995). Chapter 1 also stated that many schools embarked upon prepared thinking skills packages, prior to the emergence of *A Curriculum for Excellence*. However, it is still deeply contested as to how, and if, thinking skills should be taught.

An analysis of thinking skills approaches is important to detect elements that could form the basis of future thinking skills interventions. McGuinness (1999) identified three distinct ways of teaching thinking skills; programmes that teach ‘thinking skills’ as a discrete subject; programmes that provide structured lesson plans to teach thinking skills within a specific subject area; and programmes that aim to infuse thinking skills throughout the curriculum. For the purposes of this chapter, however, the distinction will only be made between teaching thinking through prescriptive packages and resources (whether set within a particular subject area or outwith), and teaching thinking skills by integrating them into the curriculum. This follows a similar categorisation to that of Nisbet (1990). Section 3.2 will therefore present the most common discrete thinking skills programmes intended to be slotted into the curriculum, either as stand-alone ‘thinking skills’ lessons or prepared thinking skills lessons structured within a particular curricular area. Section 3.3 will analyse the ‘infusion’ approach that aims to integrate the underpinning pedagogy of effective thinking lessons throughout the curriculum. It is not an aim of this thesis to test the merits of adopting one particular thinking skills programme over another. However, advantages and disadvantages for each approach will be discussed and any available research evidence scrutinised in relation to the creation of the intervention study conducted in this thesis. It will be shown that these main approaches are not so distinct from each other that there is no overlap between the pedagogical features typically found in both of these thinking skills approaches (for instance, developing the language of thinking, cultivating thinking dispositions, encouraging collaborative learning, developing metacognition and transfer of skills to other contexts). However, infusion lessons will be shown to be founded on the development of these core capacities of effective thinking. This is the fundamental rationale for adopting the infusion approach as the basis of the intervention study in this thesis (see Chapters 6 and 7).

3.2 Summary of Programmes Teaching Thinking Skills as a Discrete Subject

CoRT- 1 Programme (De Bono, e.g., 1981, 1985)

The CoRT-1 programme is the first in a series of six sets of thinking tools, with each set focusing on a different aspect of thinking (e.g. CoRT IV is mainly concerned with fostering creative thinking, CoRT-III with interaction). It is also the most widely used of de Bono's programmes, and, because of the length of time it has been in circulation, is possibly more widely researched than many of the other thinking skills approaches. The CoRT-1 programme itself consists of a set of seven tools at which de Bono believes children should be given explicit practice. The tools range from the commonly cited PMI (plus, minus and interesting), to OPV (identifying other people's views) and CAF (consider all factors). He believes that the tools are simple, powerful and productive and can be used to enhance thinking ability in learners of all ages. Once the children are familiar with each of the thinking tools they can be infused into subject content, although de Bono views this as a by-product of learning the tools. De Bono argues that all children would increase their capability for intelligent thought through two hours of direct instruction in the thinking tools each week (each of them to be studied individually) (e.g. 1991). De Bono argues that this way is preferable than teaching thinking by infusing it into subjects, because the infusion method is, "too weak for metacognitive training" (p. 13). He does not qualify this by explaining how his CoRT program specifically *does* focus on metacognition and furthermore, is possibly not familiar with infusion approaches in which metacognition is central (see Section 3.3 in this chapter).

De Bono (1976) discusses experiments that have taken place with children trained on the CoRT material and compares them with untrained children. He identifies the most obvious benefits from CoRT as being through the trained groups' "particularly striking" breadth and quantity of answers (given during tape-recorded discussions). Furthermore, Nickerson, Perkins & Smith (1985) explain how the CoRT program was the basis for the 'Learning to Think' project in Venezuela. They substantially expanded the programme so that four lessons were taught on each of the ten thinking

tools rather than one. However, they give credence to de Bono's findings that there is a significant difference to the quantity and quality of ideas within the groups taught the CoRT-1 lessons, and that the learners demonstrated an ability to apply the individual tools learned to other similar situations. However, they warn that, as yet, no evidence suggests that these tools can be applied to situations unlike those in which they were trained, or to other subject areas.

Edwards & Balauf (1987) attempted to obtain definitive valid and reliable data on the effectiveness of teaching all ten CoRT-1 tools over a period of four weeks on 67 students (M = 12yrs 2 months). The students were split into three groups each of which were taught the lessons in the same format but group 1 had the skills reinforced in subject areas and parental involvement was actively sought, group 2 had the same intervention treatment minus the parental involvement, and group 3's intervention focus was limited to the actual CoRT-1 10 lessons. Crucially, no control group was used. The groups were tested in a pre- and delayed post-test format, using tests such as the *Otis-Lennon School Ability Test* (Otis & Lennon, 1982), the *Torrance Test of Creative Thinking* (Torrance & Ball, 1984) and the *Self Concept as a Learner Scale* (Waetjen, 1967). In general, Edwards and Baldauf noticed an improvement in the areas of IQ, creativity (but only the aspects of flexibility and originality) and also the learners' self-concept scales. However, they found no significant difference between the results from the three different treatment groups which they believe is an important finding when considering how to implement CoRT in educational environments.

To counter criticisms of this study, Edwards (1991) carried out a subsequent larger-scale study (n = 202) but included a control group (three classes, n = 87). Again, all ten CoRT-1 lessons were taught over a period of five weeks to four experimental classes, with a pre-, post- and delayed post-test design. In addition to the methods used to evaluate the study previously, they employed the Myers-Briggs Type Indicator (Briggs & Briggs Myers, 1976), plus devised three study-specific measures; the Self-Concept as Thinker (SCAT) Scale, the Student Thinking Assessment (STA) scale and the Thinking Approaches Questionnaire (TAQ). His

findings highlighted similarities with previous work, for example in the Otis-Lennon and the Torrance tests. Whilst there was not a significant difference in the results generated from the SCAT scale, an improvement was noted in the TAQ.

From a pedagogical perspective, there are problems with implementing the CoRT programme the way de Bono originally intended it. For instance, the time-constraint difficulties with incorporating a two-hour ‘thinking skills’ lesson into the curriculum each week were referred to in Chapter 1. Furthermore, whilst this approach may encourage learners to focus their thinking on certain issues, giving them practice at using the tools (e.g., ‘CAF’: Consider All Factors; ‘AGO’: Aims, Goals and Objectives), this is no guarantee that learners are then able to associate the thinking tools with the specific thinking skills being developed. It is possible that children could complete the full CoRT thinking course without increasing their knowledge of the language of thinking and how to relate the thinking words with their specific cognitive processes. This is something that many theorists feel is central to teaching for thinking (see Section 3.3 for a discussion).

Philosophy for Children (Lipman, e.g., 1982, 1985, 1991)

The Philosophy for Children programme is one of the most widely established approaches to developing thinking, and is similar to the CoRT programme in that weekly lessons are slotted into the curriculum. In Lipman’s (1991) philosophy programme, ‘philosophy’ is taught to children in the structure of roughly two and a half hours per week. The salient points of the philosophy lesson template are that first a stimulus of typically a ‘thinking’ story is read to the children. Questions are then generated (by the children) on aspects of the story that they found interesting or puzzling. The learners then attempt to reflect on the questions they posed and evaluate their answers through dialogue, thus creating a ‘community of enquiry’. The intention is for children to realise that there are different types of questions, and to support children to progress from closed-ended questions, to more open-ended types, which allows for deeper discussion and probing of philosophical issues and values, and thus fostering appropriate thinking dispositions (such as truth, fairness, honesty, greed). Whilst Lipman (1985) lists 30 thinking skills which are promoted

through the philosophy for children programme (e.g. discovering alternatives, analysing values, making connections, giving reasons), they are covered implicitly through the stories told, and are not necessarily an explicit focus within philosophy lessons.

In the UK, Fisher (1990; 1996; 2003) has been the main proponent of developing philosophy in schools, although more recently others have followed (e.g., Cleghorn & Baudet, 2002). The materials that Fisher and Cleghorn publish, however, differ slightly from Lipman's original materials. Whereas Lipman wrote stories designed specifically to encourage learners to engage on a deeper level with important human values and attributes, the materials published by both Fisher and Cleghorn respectively are more prescriptive; not only do they provide practitioners with a story as a stimulus, they also provide a list of questions to generate discussion. Whilst there are those who believe that children cannot actively reflect on questions that they themselves have not raised, both Fisher and Cleghorn justify the inclusion of questions by claiming that they are a useful support for teachers and learners unfamiliar with the programme, as they provide an initial starting point.

There is a vast amount of literature to support the effectiveness of the Philosophy for Children programme (e.g., Lim, 1994; Lipman, 1976, 1985, 1991; Trickey & Topping, 2004; Trickey, 2006). Many of these studies have used standardised cognitive ability tests. One large-scale study (n = 2300) was conducted by the Educational Testing Service and reported in Lipman (1991). It involved a year-long investigation into the effects of exposing experimental classes to two and a half hours per week of philosophy lessons and showed gains for the experimental classes over the control classes. A second similarly structured study conducted by the same group demonstrated gains for the experimental children in terms of maths, reading and reasoning abilities (n = 200).

One of the most recent evaluations of this approach (Trickey, 2006) tested the effect of teaching one philosophy lesson per week on children's cognitive ability and critical reasoning skills. Although the specific number of children tested on each

measure varied for each test, in general a large number of classes were involved, with control classes utilised. Positive gains were identified using a pre- to post-test quantitative design involving a combination of standardised tests (i.e., Cognitive Ability Tests and Myself-as-a-Learner) and video evidence of classroom dialogue which was seen to improve. Teachers' and pupils' perceptions of changes in emotional development were analysed qualitatively through questionnaires and findings indicated gains in pupils' communication skills and confidence.

Although the philosophy lessons are taught discretely each week, proponents believe that the questioning and probing attitudes fostered, and the benefit of collaborative experiences will transcend and pervade all curricular areas. However, it is not a primary focus of each lesson to make the thinking skills learned explicit. Potentially there is the same difficulty with the implementation of this programme as with the CoRT programme; children may not be aware of the thinking skills (and the language and processes associated with them) being taught. In terms of the practicalities of supporting practitioners, it is still contested whether practitioners need to have a background in philosophy to ensure philosophy lessons with children are a success, or whether all practitioners can create effective philosophical dialogues. Furthermore, there remains a debate about how best to teach philosophy to children (e.g., Murris, 2000). Evidence is not yet available to determine whether Fisher's and Cleghorn's more prescriptive lessons detract from the essence of the philosophy for children movement as the questions are not generated from the children but pre-prepared. Furthermore, in a similar way to de Bono's CoRT programme, another potential practical difficulty is that the lengthy philosophy lessons would have to be accommodated within the constraints of the curriculum.

Instrumental Enrichment (Feuerstein, 1980)

Another equally well-established programme is Feuerstein's Instrumental Enrichment course. Like the CoRT programme and Philosophy for Children approach, this programme is a discrete resource. It is based on the premise that all learners have the potential to change their cognitive ability. In this respect his work echoes a central tenet of Vygotsky's theory (1978), that through internalising

collaborative experiences, learners will be able to increase their own individual performance on the same task on subsequent occasions. For Feuerstein, the key to developing potential lies in the mediation between the child and the environment. The mediation typically occurs by an adult intervening during a challenging task to demonstrate strategies which the child can use to enhance their understanding of the information and a situation. Feuerstein advocates the use of 14 specific instruments to accomplish this (e.g., organisation of dots, comparison, categorisation and illustrations), each of which increases in level of difficulty as the learner develops more specific methods for interpreting information. The instruments are designed to represent a separate and discrete intervention normally taking between two and three years to complete, covering roughly two – three hours per week.

Although there have been a number of studies conducted to show the effectiveness of the IE programme, (e.g., see Burden, 1987 for an overview; Link, 1991), the results are contradictory. For example, Burden and Florek (1989) report that the majority of studies of IE, “show conclusively that performance in IQ tests is significantly affected by exposure to IE programme” (p. 78). However, as referred to in Chapters 1 and 2, the concept of ‘intelligence’ is complex with many theorists arguing against the ability of IQ tests to measure one’s capacity for intelligent behaviour. Furthermore, the relationship between increasing intelligence and developing thinking skills is, as yet, not agreed. The difficulties in assessing a discrete programme in terms of its aptitude to transfer abilities positively to affect educational attainments and not just general ability intelligence tests is also noted by many researchers including Burden and Florek (e.g., Burden & Florek, 1989; Burden, 1987; Nickerson et al., 1985; Wilson, 1999). Similarly, one large-scale study conducted by Blagg and Ballinger incorporating control groups found that, whilst the project was successful in terms of increasing teacher motivation and pupils’ attitudes, that analysis of the findings highlighted, “no evidence of ability or attainment changes” (1989, p. 90). Teachers found the process of developing transfer of the discrete skills and strategies taught within the programme problematic.

Whilst, like the Philosophy for Children programme, this method is one of the more internationally used methods to develop children's thinking ability, one reason why more education authorities have not embarked upon this programme is possibly because of the practicalities of managing this programme within general constraints. For instance, not only is it recommended that the lessons occur two to three times per week, they are ideally to be conducted with individuals or small groups so that each group member's potential can be increased through individualised mediation. For this reason, the method works best as Feuerstein had intended it (with lower-achieving children) and would be more difficult to manage as a whole-school approach. Furthermore, as it is recommended that teacher training involves a minimum of 45 hours of in-service annually (Link, 1991), it is unlikely to remain a viable and sustainable long-term approach in schools other than those specifically for low-achieving adolescents, where it would be more workable. Despite the lengthy teacher-training needed for this programme, as the training and IE programme is so specific, it is likely that no impact would be made on teachers' general methodological style outwith the IE lessons.

Cognitive Acceleration (CA)

Unlike the above programmes, 'Cognitive acceleration' (CA) is an over-arching term within which a variety of specific programmes sit. All CA individual programmes are based on three main 'pillars'; cognitive conflict, social construction and metacognition. These three core theoretical elements form the foundation for each CA lesson. To aid the transition from theory to practice, two other elements are added to the basic lesson template; concrete preparation (the beginning of each lesson which introduces relevant language and the activity); and bridging (incorporated occasionally at the beginning of a lesson but typically at the end to discuss skill application in other contexts). Over the years, various CA programmes have been devised and in-depth research conducted.

The CASE programme (Cognitive Acceleration in Science Education) was the first main cognitive acceleration approach (Adey, Shayer, & Yates, 2001), and the majority of research on the cognitive acceleration programmes is concerned with this

specific project. 'Thinking Science' (the published version of the CASE programme) consists of 30 lessons, to be taught over a period of two years. The first project to analyse the CASE results (Adey & Shayer, 1994) showed gains of up to one GCSE grade in science, maths and English, from a longitudinal study conducted over a span of 2 years. This effect was sustained to a delayed post-test three years after the end of the intervention. More recent data gathered from a larger sample (Shayer, 1999) confirms findings from earlier studies, which highlights that CASE schools involved in the project score consistently higher GCSE grades, not only in science but also in maths and English. Shayer and Adey (2002) believe this provides further confirmation of the effects of transfer to general intelligence, something which few thinking skills programmes would explicitly claim.

This approach has been adapted for different age groups (e.g., 'Let's Think through Science! Adey, Nagy, Robertson, et al., 2003) and different subjects (e.g., CAME: cognitive acceleration in maths education; CATE: cognitive acceleration in technology education). Although research into the effectiveness of these packages is on-going, *Let's Think!* (a CA programme for 5-year-olds) has also been investigated in-depth (e.g., Adey, 2002). The *Let's Think!* research team investigated the effects of this programme by analysing the results of children drawn from 14 trial classes and 8 control classes, using a pre- post-test format a year apart (during which time the total programme of 26 lessons was administered) (Adey, 2002). The children were assessed on two schemata of drawing and conservation. Data showed significant gains in cognitive development from those children involved in the trial lessons, in both spatial perception and conservation. Adey believes that, as this effect was apparent in the taught schema ('drawing') and in conservation (which was not taught in the programme), it indicates that transfer occurred and that the lessons therefore impacted on children's general cognitive development. No evidence was gathered on the extent to which these improvements were related to the school curriculum.

The lesson plans within the *Let's Think!* pack are extremely structured and involve the children thinking actively with prepared resources that accompany the pack. This

can be a useful prop for those teachers less confident and familiar with teaching thinking. Furthermore, unlike some of the programmes mentioned previously in this section, these lessons explicitly encourage the teacher to develop children's metacognition and to recognise opportunities to transfer the thinking to other contexts. However, as each of the lessons are ideally to be taught to groups of six children at a time (i.e. the same lesson would be taught to a different group each day of the week), this produces many difficulties for classroom organisation and teaching methodology with five-year old children. Furthermore, with this approach, the lessons are taught as a discrete subject within the curriculum, something which could be dangerous to encourage very young children that thinking mainly takes place in the 'Let's Think!' lessons. Whilst there is time set aside for transfer to other curricular areas, it is problematic as the concepts that the children have been dealing with are so abstract. Despite the strong focus on developing thinking skills within this programme, thinking skills are not explicitly taught; children are not introduced specifically to the language of thinking or introduced to the skill by its actual name, the skill is introduced by the activity. Whilst opportunities for collaboration are apparent, they involve the teacher leading the six-member strong groups.

Summary

In general, these programmes have all stated the intention to develop children's thinking skills, typically through collaborative activities of some sort. The various programmes also focus on developing metacognition and transfer to other situations, although this varies to a greater or lesser extent depending on the programme. In general, the prescriptive nature of the majority of these programmes could benefit teachers less confident about how to 'teach' thinking skills. However, this benefit is perhaps outweighed by the problem of how these thinking skills discrete lessons will impact on other curricular areas; these programmes typically involve training teachers how to teach specific resources rather than how to teach for effective thinking through their methodologies. Furthermore, Chapter 2 highlighted that teachers' daily classroom practices affect children's self-beliefs, confidence and motivation. This implies that children's self-concepts might be impacted upon to a greater extent when interventions train teachers to infiltrate the essence of teaching

for thinking through their classroom practices in general, rather than through isolated, prescriptive resources.

3.3 Infusing Thinking Skills into the Curriculum: The Underpinning Pedagogy

In contrast to the discrete thinking skills programmes discussed above, many theorists believe that thinking skills, strategies and dispositions should be infused into existing curricular areas. In this way the infusion approach would not involve practitioners teaching isolated thinking skills lessons each week, but instead train practitioners to integrate the underpinning pedagogy of effective thinking into their classroom practices. The difficulties with finding time within the curriculum to include a separate thinking skills programme have been discussed in the previous section. An obvious benefit of the infusion approach is therefore that the thinking skills are taught alongside the subject content; the thinking skills are injected into content matter to provide more active learning and thinking situations. As Resnick argues, "...it provides a natural knowledge base and environment in which to practice and develop higher order skills" (1987, p. 35). As the children are taught the thinking skills simultaneously with the content, children will be taught the skills in 'real' contexts. Furthermore, the infusion approach has the potential to impact on teachers' methodologies, and is broader in pedagogical outlook than some of the discrete thinking skills programmes. Resnick and Klopfer have coined the phrase, 'The Thinking Curriculum' to denote the infusion approach and argue:

The Thinking Curriculum is not a course to be added to a crowded program when time permits. It is not a program that begins after the "basics" have been mastered. And it is not a program reserved for a minority of students, such as the gifted or the college bound.

(1989a, p. 2)

In this way, the infusion approach addresses the concern raised by many theorists in Chapter 2 that often only the 'more able' students are thought capable of being taught higher order thinking skills. Resnick and Klopfer believe that it is an ability

that can be fostered in all children and that the thinking should be infused throughout the curriculum:

In this vision of the Thinking Curriculum, thinking suffuses the curriculum. It is everywhere. Thinking Skills and subject-matter content are joined early in education and pervade instruction. There is no choice to be made between a content emphasis and a thinking-skill emphasis. No depth in either is possible without the other.

(1989a, p. 6)

Similarly, Pithers and Soden contend that:

The notion that abilities encompassed by the term critical thinking should be taught in separate ‘add-on’ courses has given way because of emerging literature which supports the notion that such abilities can be developed more effectively in the course of teaching subject-matter content.

(2000, p. 243)

Both Swartz & Parks (1994) and McGuinness (2000a; 2003) advocate teaching thinking by infusing thinking skills explicitly into subject content areas and have further developed the concept of the infusion approach. Their more recent and more specific interpretations of what it means to ‘infuse’ thinking skills includes the promotion of a framework to identify core thinking skills (discussed in Chapter 1), and lesson templates to support practitioners. It is widely recognised that the ‘infusion’ generic lesson template involves the explicit emphasis of thinking skills alongside subject content, fostering thinking dispositions, developing metacognition and transfer of skills and dispositions to other contexts. Each of these will now be discussed briefly in turn, as they will form an integral part of the intervention lessons presented in Chapters 6 and 7 of this thesis.

Related to the concept of teaching thinking skills explicitly is that the teachers and the learners are aware of how to apply the cognitive processes of each thinking skill. Ensuring learners are aware of the skills they are employing is a necessary first step towards developing effective thinking, as only then can learners metacognitively

reflect on the thinking that has taken place and recognise areas where it would be useful to generalise the skill to other contexts. Some theorists therefore suggest teaching thinking skills by highlighting the key thinking steps involved in each skill (e.g., Beyer, 1991; Swartz & Parks, 1994). Connected to making the thinking skill taught explicit, is the importance of developing the language of thinking in classrooms so that learners are associating thinking words with their relevant cognitive processes (e.g. Beyer, 1987, 1997; Costa & Marzano, 2001; Fisher, 2003; Kirkwood, 2005; McGuinness, 2003; Tishman & Perkins, 1997; Tishman et al., 1995; Wertine, 1987). Words such as summarise, estimate, conclude, classify, order, reason, doubt and imply can be associated with precise cognitive skills, each of which directs the learner's attention and focuses them exactly on the type of thinking needed. Children are often instructed to 'think harder' in classrooms, yet whilst they may *look* like they are thinking harder, it is possible that there is no change in the cognitive operations they are employing in their heads (this is investigated in Study 2 of this thesis). The way in which this is conducted in learning environments can often be achieved by higher-order questioning. The importance of practitioners encouraging learners to be inquisitive and curious cannot be underrated in the quest to develop effective thinkers (e.g., Claxton & Lucas, 2004; Fisher, 1990; Kirkwood, 2005; Osborn, 1953; Sternberg, 1994). Central to the infusion method is therefore developing the language of thinking throughout daily classroom practices.

In Chapter 1 the importance of fostering thinking dispositions was reflected in many of the thinking skill frameworks and definitions (e.g., Ennis, 1987; Facione, 1998; Halpern, 1997; Paul, 1993). Practitioners' awareness needs to be raised that if a child is an 'effective thinker', then it will mean that they are able not just to apply thinking skills when directed, but that they have the inclination to use such thinking skills. In other words, the aim is for children to become 'habitual' rather than 'episodic' effective thinkers (McCarthy, 1992). To foster this, teachers need to model appropriate thinking dispositions so that learners continually use the skills that they acquire (Beyer, 1987; Claxton, 2002; Costa & Kallick, 2000; Perkins, Jay, & Tishman, 1993). Costa's most recent work cites sixteen Habits of Mind (e.g. 2000)

essential for intelligent thought, although he does not claim that each habit should be understood in isolation or that his list is exhaustive (e.g., ‘persisting’, ‘striving for accuracy and precision’, ‘thinking about our thinking’). Similarly, Tishman et al. (1995) list five broad dispositions (each of which is made up of more detailed aims) for ‘good thinking’ (e.g., ‘Be curious and questioning’, ‘Be clear and careful’). They believe dispositions are entirely teachable when modelled and cultivated within appropriate cultural contexts (such as the classroom). Whilst, as with the frameworks, experts do not all agree on the exact types of dispositions to be fostered, there is general consensus that dispositions are fundamental to the effective application of higher order skills. As such, any programme seeking to cultivate ‘good thinking’ would specifically highlight the crucial part that dispositions have to play in developing the habitual effective thinker, and thus learners should be encouraged to model these dispositions and integrate them into their ‘habits of mind’.

As Chapter 1 illustrated, the development of metacognition is fundamental to enhancing effective thinking and increasing intelligence (e.g., Grotzer & Perkins, 2000; Larkin, 2002; Moseley, Elliot, Gregson, & Higgins, 2005). Therefore, for any thinking skills intervention to be successful, learners need to be encouraged to be clear about the type of thinking warranted in individual situations. This might involve discussing how to accomplish their goal, reviewing their progress in relation to various factors, evaluating and reflecting on the type of thinking they were employing (i.e., how they executed it and the thought processes involved) and how successful their thinking was (i.e., the extent to which their goals were accomplished).

Another core element of infusion lessons is the importance of transfer. Children need to be able to organise, communicate and act on their knowledge of content, skills and dispositions (Perkins, 2001). The ultimate aim of education is to make use of school-learning in real life situations, otherwise knowledge learned becomes inert (Perkins & Salomon, 2001). For transfer to occur, learners need to identify and engage in opportunities to practise it, and as Tishman et al. note (1995), research suggests that transfer will not happen automatically, practitioners need to teach

actively for transfer (also see Ashman & Conway, 1997; Haskell, 2001). Moseley et al. concur with this and report that a number of studies have supported the claim that transfer is hard to ensure (2005).

A key strategy adopted by both Swartz & Parks (1994) and McGuinness (2003) to help learners structure their thought processes and merge subject content with thinking skills, is through the use of skill-specific graphic organisers/thinking diagrams. The diagrams act as frameworks through which children's thinking processes can be clarified. This ensures that they are actively practising all key stages of each skill. The benefits of employing graphic organisers to enhance children's thinking is widely recognised (Beyer, 1997; Clarke, 1991; Hyerle, 1991, 2001; Kirkwood, 2005; Lochhead, 2001; McCombs & Whisler, 1997; McGuinness, 2003; Nessel & Baltas, 2000; Perkins, Goodrich, Tishman, & Owen, 1994; Sholseth & Watanabe, 1991; Swartz, 2001a; Swartz & Parks, 1994). Furthermore, the thinking diagrams can often help to teach the thinking skills found in many frameworks developmentally.

There are therefore many proponents of the 'infusion' approach. Many theorists concur that core elements of effective thinking (such as making the thinking explicit, fostering dispositions, developing metacognition and transfer) should be promoted in learning establishments. Collaborative learning is also an important part of infusion lessons, and this will be discussed in Section 3.4. However, in terms of an empirical validation of the infusion approach, only a few researchers have provided concrete examples.

Whilst Kirkwood (2001) demonstrated how infusing thinking skills into the curriculum for one secondary school class was beneficial, McGuinness is gathering research on the effectiveness of the infusion approach through a number of large-scale interventions. Although much of her research into the effectiveness of the infusion approach is currently on-going, preliminary findings of her first evaluation were positive (the initial study did not attempt to detect change in children's learning gains) (McGuinness, 2000b). The teachers (who were trained to design their own

infusion lessons and supported throughout with the implementation) involved with the study highlighted key benefits seen in:

children's greater reasoning powers and increased creativity, their ability to clarify their thinking processes, to see links between different subject areas, and to be more structured and focused in their approach to thinking

(2000a, p. 11)

Her more recent evaluation of her ACTSII infusion intervention is being conducted on a larger scale (i.e., 150 teachers, intervention sample – 700, control group – 550) and over a period of 3 years. McGuinness is adopting a three-pronged approach to analysing the data from this study. Whilst the analysis is in the early stages, the first approach detects children's gains in terms of educational attainment, standardised cognitive ability tests, self-perceptions of learners, (as measured by McCombs' ALCP scale, 1999) and perceptions of teachers. The second strand will attempt to analyse classroom dialogue from a metacognitive perspective, and the third goal is to formalise the training procedures and handbook devised in support of the intervention to ensure the sustainability of the 'infusion' approach (McGuinness, 2005a, 2005b).

It is clear that the infusion approach holds many possible benefits and has the potential to impact on teachers' pedagogies and children's thinking skills. However, it is also evident that more research is needed to determine the effectiveness of infusing thinking skills into the curriculum. Research should also examine the importance of focusing on not only thinking skills, but also thinking dispositions, metacognition and transfer to other areas, which are widely accepted to be core elements of effective thinking.

3.4 Collaborative Learning

The majority of theorists (including proponents of both the discrete and infusion approaches) actively encourage learners to work collaboratively to develop thinking skills (e.g., Adey, Robertson, & Venville, 2001; Adey, Shayer et al., 2001; De Bono,

1999; McGuinness, 2003; Swartz & Parks, 1994). Collaborative learning involves children of a similar age working together in groups and its rationale is found in Piaget's and Vygotsky's research. More recently, theorists within the field of thinking skills have argued that collaborative learning will enhance children's thinking skills by encouraging learners to think through challenging tasks with their peers, rather than working on the tasks individually. As Resnick states:

Engaging in higher order thinking with others seems likely to teach students that they have the ability, the permission, and even the obligation to engage in a kind of critical analysis that does not always accept problem formulations as presented or that may challenge an accepted position.

(1987, p. 41)

Wegerif (2002) concurs that collaborative learning within the curriculum improves children's ability to think critically specifically by reasoning, and in general enhances the effectiveness of most activities. He believes that:

... the positive effect of collaborative learning is amplified if learners are taught to reason about alternatives and to articulate their thoughts and strategies as they work together.

(2002, p. 3)

Wegerif & Mercer (1997) claim that one of the main ways of fostering the ability to 'reason' is through interaction and collaboration with others, and have named this 'exploratory talk'. Wegerif is keen to point out however that exploratory talk by itself does not directly teach children how to think. Instead it serves to:

...open up and maintain an intersubjective space of creative diversity in which alternative solutions to problems are generated and allowed to develop and compete as ideas without threatening either group solidarity or individual ego-identity.

(2001, p. 9).

To provide evidence for his claims, Wegerif (2000) conducted a teacher-researcher led ten-week intervention with matched control and collaborative learning conditions (six classes in total). He found that exploratory talk (e.g., reasons are expected, challenges are accepted) led to more effective discussion of key issues and participants showed improvement in science concepts.

Gokhale (1995) conducted one study which specifically examined the claim that collaborative learning enhances effective thinking. She based her small-scale study ($n = 48$) on two claims made by Johnson and Johnson (1986 in Gokhale); that collaborative learning incurs 'higher levels of thought' and increases learners' ability to remember information as compared with individuals working independently. Pre-tests and post-tests were administered and it was found that students who participated in collaborative learning had performed significantly better on the critical thinking test than students who studied individually. However, both teaching methods were found to be equally effective in gaining factual knowledge on a 'drill- and- practice test'. Qualitative comments made from the participants suggested that there were added benefits for the collaborative learning groups in terms of engaging with the material, task-enjoyment, motivation and decreased anxiety.

Whilst Tan, Gallo, Jacobs et al. (1999) suggest that a variety of research indicates that, "cooperative learning is believed to promote thinking and creativity in many ways" (p. 2), with the exception of these aforementioned studies, there is a dearth of research evidence to support the claim that collaborative learning enhances children's ability to think. However, broad claims are frequently made regarding the correlation between the two concepts. For example, Murphy states, "The discourse students engage in during collaborative action progresses thinking..." (1999, p. 258). The general trend is that the research reviewed within this domain highlights collaborative learning as being beneficial (e.g., Blaye, Light, Joiner, & Sheldon, 1991; Messer & Pine, 2000), but the majority of research has centred around the effectiveness of collaborative learning in general and the factors associated with children's successful collaborative experiences. As Messer and Pine (2000) note, "It also remains an open question as to why some children benefit from the collaborative

learning experience whilst others do not” (p. 19). This was perhaps one of the problems that some researchers have attempted to solve by imposing a structure on children’s collaborative learning experiences. Wegerif and Mercer, for instance, attempted to address this issue by basing their collaborative learning session on their ‘exploratory talk rules’ (1997) mentioned above. Murphy (1999), on the other hand, suggests providing a structure through continuous teacher support. She argues that for this to be effective the teachers must be aware of the “barriers” to collaboration and the type of teacher input needed to overcome these. In Murphy’s point of view, the key to making collaboration successful is that it involves, “students engaging with each other’s thinking” (1999, p. 259). Similarly, Ruddock (1989) cautions that communication between pupil and teacher will be fundamental to the success.

In a similar vein, adopting a collaborative approach to learning is a method which many practitioners feel uncomfortable about due to the inherent classroom dynamics associated with collaborative learning (e.g., Tolmie, Thomson, & Foot, 2000). Other key factors believed by some theorists to contribute to the success of collaborative learning include; the gender distribution within groups (e.g., Murphy, 1999; 2000); the importance of all group participants understanding and working towards a shared goal (Bennett & Dunne, 1992; Murphy, 1999); the extent of knowledge the teacher has on how best to support collaborative learning, (Bennett & Dunne, 1992; Murphy, 1999); the importance of the groups formally planning together and openly negotiating about a variety of possibilities (Barbieri and Light, 1992; Light et al., 1994 in Murphy); the motivation of individuals within groups (Azmitia, 2000; Crook, 2000); the development of core collaborative skills (e.g., intersubjectivity, planning, communication and inhibition skills) (Ding & Flynn, 2000); the general intelligence and ability of the group members (Ding & Flynn, 2000); the relationship between the children involved and children’s prior experience of the task content (MacDonald & Miell); and the interaction between peer collaboration and ‘expert’ tutoring (Howe, Duchak-Tanner, & Tolmie, 2000).

It would be outwith the scope of one study to investigate all of these issues raised regarding the factors associated with collaborative learning. There is obvious potential for collaborative learning to enhance thinking skills but few have explored

it explicitly. Further research is needed to give strength to the widely accepted belief that collaborative learning should be integrated into teaching practices to enhance children's cognitive (and metacognitive) thinking skills. As such, this is a focus for the intervention study presented in Chapters 6 and 7 of this thesis.

3.5 Implications for the Evaluation of Thinking Skills

Interventions

This chapter has highlighted the diversity of some of the main intervention studies conducted and the means by which they are evaluated. It is evident from the diversity of assessment techniques employed that the evaluation of thinking skills remains deeply contested. The difficulties identified in this chapter will be addressed in the evaluation of the thinking skills intervention presented in Chapter 7 of this thesis. However, the fact that very little conclusive research has been gathered to substantiate the benefits associated with teaching children to think is indicative of the inherent difficulties of assessment in this field (Asp, 2001; Nisbet, 1991). Whilst there is general agreement over aspects relating to the validity of tests (e.g., pre and post-tests should be conducted, a control group should be used and a variety of measures should be employed to detect changes) (Asp, 2001; Baron, 1987; Costa, 2001), there are no widely accepted tests to identify changes in individual thinking skills. Many researchers advocate utilising a variety of methods, such as; formative assessment strategies where the focus is on pupils' self and peer evaluation (Costa, 2001; Kirkwood, 2005; Tishman et al., 1995); keeping on-going journals of progress or portfolios (Costa, 2001; Fisher, 1990; Stone, 2001); or using observation checklists when monitoring the 'thinking ethos' within learning environments, both for pupils and teachers (Beyer, 1987; Stone, 2001). However, whilst these can provide detailed formative evidence, they are often not sensitive enough or used with enough structure to detect definitive progress within thinking skills interventions.

With regard to the evaluation of the thinking skills intervention conducted in this thesis, the first main message from research appears to be that, if 'tests' are to be conducted, that they relate as closely as possible to the skills learned and that they involve the active application of those skills (Asp, 2001; Beyer, 1987; Burke, 2001;

Costa, 2001; Fisher, 2001; Kirkwood, 2005). This is one of the pitfalls of standardised assessments of thinking skills; often they are too broad to generate meaningful data (de Bono, 1976). Instead Beyer (1987) advocates using a six-test assessment format involving definition of the skills, identification of an example of the skill in use, three opportunities to apply the skill, and an explanation of how they executed the skill. This method of assessment would be able to assess change in thinking skills taught through discrete programmes and those infused throughout the curriculum. Secondly, as learners' self-concepts will determine to a large extent their motivation and ability to achieve, it can often be useful to monitor their views of themselves as thinkers and whether they believe that their abilities are malleable (Dweck, 1999). Thirdly, as metacognitive ability is such an important factor in determining how well a learner is able to perform other skills, that some way is devised to determine any changes in metacognitive as well as cognitive skills. Fourthly, if tests are assessing a learner's ability in thinking skills then the tests employed should not merely assess a learner's ability to recall and identify other thinking skills, but actively examine their ability to put them into practice through the use of open-ended questions (Asp, 2001; Stone, 2001).

3.6 Conclusions and Implications for this Thesis

This chapter has surveyed some of the main thinking skills programmes currently in use in educational establishments, and made the distinction between programmes teaching a structured series of pre-prepared lessons and the infusion approach, which injects effective thinking elements into the curriculum as opposed to inserting a discrete 'thinking skills' subject into the already overcrowded curriculum. The underpinning pedagogy of the infusion approach has been analysed and the generic 'infusion' lesson template was seen to develop not just thinking skills, but also thinking dispositions, metacognition, transfer, and to enhance these through the teaching strategy of collaborative learning. Some of these aspects were also present in many of the discrete thinking skills programmes discussed but, taken together, did not represent the underlying ethos of any.

Many intervention studies have been discussed in this chapter. However, it is difficult to ascertain clear messages about how an intervention should be structured as typically previous intervention studies have varied in terms of length of intervention, age of pupils involved, type of thinking skills programme implemented and differences in outcome measures. In a similar vein, this chapter has also emphasised the complexities involved with assessing thinking skills, although a trend emerging is that a combination of standardised and skill-specific qualitative and quantitative measures should be used. In this respect, Beyer's six-task format has the potential to be a successful tool in directly assessing the thinking skill taught from a variety of angles, and produces data that can be analysed both qualitatively and quantitatively. Similarly, whilst many intervention studies presented in this chapter analysed children's concepts of learning, it would appear that, as yet, no interventions have attempted to analyse children's baseline understandings of what it means to be a 'good thinker'. For example, it is not known whether children understand the elements involved and know how to improve their thinking. Moreover, seldom are children's baseline knowledge of thinking skills investigated prior to these interventions. Furthermore, whilst the majority of thinking skills programmes evidently encourage children to complete thinking activities in collaboration with peers, it is clear that relatively little research exists which supports the belief that collaborative learning enhances pupils' thinking skills. These factors were taken into account in the thinking skills intervention study presented over Chapters 6 and 7.

This thesis will, in the next three empirical chapters, report data gathered in specific studies. The chapters present baseline data on children's (and teachers') concepts of the skills involved in effective thinking, and analyse how these change when a thinking skills intervention (based on the infusion approach) teaches thinking skills explicitly. Study 1 to be reported in the next chapter, provides new data on teachers' concepts of effective thinking, their views of the effectiveness of collaborative learning, the extent to which broad thinking types and individual thinking skills are taught throughout the curriculum and whether they are taught developmentally. Study 2, reported in Chapter 5, contributes to developmental research on children's

concepts of intelligence, explores children's concepts of effective thinking and their knowledge of individual thinking skills. The baseline data gathered from these first two studies, plus evidence and literature discussed in Chapters 1 to 3 of this thesis, contributed to the creation and evaluation of the intervention study, presented over Chapters 6 and 7. The thinking skills intervention presented as Study 3 takes into account the complexities involved when deciding how best to teach and assess thinking skills. In addition to providing much-needed research on the effectiveness of a pedagogy infusing effective thinking into the curriculum, it specifically tests the benefits of incorporating collaborative learning into lesson structures. The findings from the work to be reported aim to contribute to the relatively under-researched domain of teachers' and children's perceptions of effective thinking, the success of collaborative learning as compared with individual learning and the means by which thinking skills interventions are conducted and assessed.

CHAPTER 4

STUDY 1: TEACHERS' PERCEPTIONS OF THINKING SKILLS WITHIN THE PRIMARY CURRICULUM¹

4.1 Aims of this Chapter

This chapter will build on the literature presented in the introductory chapters of this thesis and present the methods and findings of a questionnaire-based study of primary teachers. This study had two purposes. The first aim of this study was to explore teachers' beliefs about thinking skills taught within the curriculum, an area which Chapter 2 highlighted as being under-researched. Data was also gathered on this to provide valuable baseline information for the intervention study (presented over Chapters 6 and 7 of this thesis), of which an important part is building on teachers' understanding of thinking skills and providing training on how to integrate them into the curriculum. The second aim of this study was to enhance current policy and practice developments. As discussed in Chapter 1, although Scottish national curriculum guidelines 5 –14 (1991) with some revisions remain in force, raised awareness of The National Priorities in Education (Scottish Executive, 2000a) and publication of *A Curriculum for Excellence* (Scottish Executive, 2004) is generating further change. It seems important then that baseline information on current practice of thinking skills within classrooms is used to make links with future policy innovations.

¹ Data from this study is published in *Research in Education*, No. 77, May 2007 (see Appendix F) and has been presented at the Scottish Educational Research Association 2005th annual conference, and Falkirk Council's *Learning to Achieve* 2006th annual conference.

4.1.1 Identifying Perceptions of Thinking Skills

Chapter 1 explored theorists' definitions of effective thinking and identified that thinking skills commonly categorised in theoretical frameworks include metacognitive skills, critical and creative thinking skills, information processing skills, decision making and problem solving strategies. Following this, the investigation into teachers' concepts of effective thinking (presented in Chapter 2) highlighted the lack of research within this area. For example, little research exists to determine how practitioners understand the concept of 'thinking effectively'. Gathering this information will be fundamental to the success of the thinking skills initiative, as Chapter 2 raised awareness of the theory that teachers' beliefs and classroom practices affect learners' concepts (Dweck, 1999; Pretzlik, Olsson, Nabuco, & Cruz, 2003; Stipek, 1981).

Chapter 3 discussed a variety of specific thinking skills interventions conducted recently, either by teaching thinking skills in discrete programmes or by infusing them into existing curricular content. However, research conducted on many of these approaches has not tended to first establish teachers' baseline perceptions of how frequently thinking skills are taught within the curriculum before expecting teachers to intervene using a specific thinking skills approach. Similarly, Chapter 1 highlighted that few thinking skills frameworks classify thinking skills according to children's developmental ability. Discovering whether teachers appear to be teaching age-specific thinking skills will provide a valuable contribution to discussions about the level of guidance required to support the implementation of the thinking skills initiative.

Chapter 3 also noted that the majority of thinking skills approaches advocate the incorporation of collaborative learning into teaching methodologies (e.g., Gokhale, 1995; Howe, Duchak-Tanner, & Tolmie, 2000; Wegerif, 2000). Little research exists on the effectiveness of this in terms of enhancing thinking skills. Moreover, as classroom practitioners are expected to provide opportunities for children to learn collaboratively, an interesting focus for research would be the extent to which practitioners perceive collaborative learning to be a successful aspect of pedagogy.

4.1.2 The Present Study

As highlighted in Chapter 1, the intention to develop effective thinking within learning environments sits at the heart of established effective learning and teaching policies (e.g. Scottish CCC, 1996; HMI, 2002). Therefore an important step in encouraging practitioners to teach thinking skills explicitly, is first to gather baseline data on which thinking skills are currently being taught and the extent to which they permeate the curriculum. This will enable stronger links to be made with current good practice and future policy developments (encouraging thinking skills interventions to build on the skills currently taught).

The collection of data for this study, the first of three linked studies presented in this thesis, was timed to coincide with the secondment of the researcher as the Thinking Skills Support Teacher to the local authority in which the research was conducted. This meant that the researcher was able to establish positive working relationships with senior management, staff and children throughout the authority during the administration of all three studies. This study was conducted prior to the launch in schools of a significant staff development initiative on formative assessment strategies and before teachers were aware of the emphasis given to thinking skills within the framework of *A Curriculum for Excellence* (Scottish Executive, 2004). Schools participating in this study had therefore not received explicit thinking skills training at the time the audit was conducted. As the research presented in this thesis will demonstrate, the three linked studies were conducted as part of a policy-building exercise and with a view to informing staff development regarding how to teach thinking skills. The main research questions were:

- What do practitioners understand by the term ‘effective’ thinking?
- What are practitioners’ views on collaborative learning?
- Which thinking types are taught most frequently within the curriculum?
- Within those thinking types, is a broad range of individual thinking skills promoted?
- In which curricular areas are thinking skills most frequently taught?

- Are there developmental trends in the way in which thinking skills are taught to children aged 5 – 7 years and 8 – 12 years of age?

4.2 Method

4.2.1 Participants

All forty-eight primary schools in a region within central Scotland were asked to complete a questionnaire-based audit. The questionnaire was conducted by the education authority's 'Thinking Skills Development Group' as an assessment of good practice prior to formulating the authority's policy and guidelines on 'Effective Thinking'. The self-complete questionnaire was sent out to schools in October 2004. At the time of data collection all schools within the authority either had thinking skills in their development plan for that session or the next academic year. As this questionnaire was not detailed in the local education authority's Service Plan, it was not compulsory for schools to participate. In total, thirty-six of the forty-eight primary schools returned questionnaires. Teachers were given the opportunity either to complete the questionnaires working with their stage partners or individually. One hundred and twenty seven completed questionnaires were received. All stages within the nursery and primary sector were represented including; additional support needs units, senior management teams and visiting specialists.

4.2.2 Materials, Procedures and Coding

Due to the policy drive of this study, the aim was to gather lots of data from a relatively large sample of practitioners. For this reason, data was elicited through a questionnaire-format rather than interviews. The questionnaire was piloted at a half-day course for Senior Management Team members ($n = 33$). During this session the delegates were given the opportunity to complete the audit and then work in groups to suggest any possible changes. Feedback was received in terms of purpose, content, format, layout and intended audience. In light of these suggestions it was revised and sent out to schools (see Appendix A).

There were two main sections to the questionnaire. The first section consisted of four open-ended questions concerning teachers' beliefs about effective thinking and collaborative learning. The second section presented the thinking skills listed within the framework of McGuinness (2003) (discussed in Chapter 1). This section asked practitioners to rate the frequency with which they perceived each of the thinking skills to be taught within the curricular areas.

Regarding the detail within the first section of the questionnaire, the first question, ("How would you define the term 'effective thinking'?") was intended to discover what practitioners understand by the term 'effective thinking'. Questions 2, 3, and 4 were related to collaborative learning. Question two probed teachers' beliefs about whether children think better working individually or collaboratively ("In your opinion, do children think better working individually or collaboratively?"). Question three detected whether practitioners believe children *prefer* working mostly as individuals or collaboratively ("Do you think children prefer mostly to work as individuals or in collaboration with their peers?"). The final question in this section asked practitioners to state whether *they prefer* to have children working individually or collaboratively ("Do you prefer to have children working individually or collaboratively?").

The responses to these questions in the first section of the questionnaire were coded to explore teachers' views. The data was then interrogated to derive broad themes using content analysis. The content analytic method has the advantage of providing both qualitative and quantitative data (Krippendorff, 1980; Weber, 1995). The coding procedure involved a sub-set of 20 questionnaires being coded by the researcher and an independent blind coder. The inter-judge reliability score was 90% on the first of these four questions and 100% on the three questions connected with collaborative learning. The four categories established when analysing responses to the question, 'How would you define the term 'effective thinking'?' were; Don't know; Knowledge (e.g., "the ability to memorise information"/"to know a lot of facts about a lot of different subjects"); Thinking Ability (e.g., "thinking critically about things"/"being able to solve problems, e.g., in maths"), and Good Citizen (e.g.,

“being able to follow instructions”/“listening carefully in lots of situations”). To code data from questions 2, 3, and 4 concerning beliefs about collaborative learning, the three categories derived from the practitioners’ responses were ‘Individual’, ‘Collaborative’ and ‘It depends’ (e.g., on the individual pupils involved, on the situation, the task format and the curricular area).

Regarding the data elicited from the second section of the questionnaire, respondents were asked to rate how frequently they perceived each thinking skill within the six main thinking types in the McGuinness (2003) framework (i.e., searching for meaning, critical thinking, creative thinking, metacognition, decision making and problem solving) to be taught in each curricular area. By way of example, within the thinking type of ‘critical thinking’, respondents had to rate how often (in each curricular area) they taught the following skills: making predictions & formulating hypotheses, drawing conclusions, giving reasons, distinguishing fact from opinion, determining bias, reliability of evidence, being concerned about accuracy, relating causes & effects and designing a fair test. Responses were recorded using a Likert-scale grading of 1 (do not use) to 5 (use all of the time) to allow for parametric analysis of responses.

4.3 Results and Discussion

The results to the first section of the questionnaire will be reported qualitatively. This section includes an analysis of teachers’ responses to questions about their views of effective thinking and collaborative learning. Data from the second section of the questionnaire were statistically analysed to reveal teachers’ use of thinking skills within the curriculum. Furthermore, data were interrogated to reveal developmental trends in the way in which children in early years (5 – 7 years) and in middle/upper primary (8 – 12 years) are exposed to thinking types. To analyse these potential developmental trends, only some data sets were included ($n = 52$), as, for instance, where respondents were perhaps teachers from rural schools and were completing one audit to represent their teaching of all children in the school, or when senior management teams with a whole-school teaching remit completed a

questionnaire, these had to be excluded from the analysis as they could not be included in either the 5 – 7 or the 8 – 12 year group alone.

All data returned was entered into the data set, and missing data entered as zero on the SPSS data set. Due to the size of the questionnaire and the fact that the majority of participants were not given time to complete the questionnaire within their collegiate activity time, the achieved sample for each analysis was lower than the number of questionnaires returned for the majority of sections. For this reason and to make each analysis robust, there was conservative treatment of the data. For example, where there were some missing data that resulted in partially incomplete data for each thinking type, for analytical purposes that respondent was excluded from analysis of that thinking type. Therefore for every analysis reported, all respondents gave complete answers for that thinking type. This resulted in the analyses often being conducted on a sub set of data. The treatment of the incomplete data may give the impression that there were more missing data than there actually were. However, the sample numbers were similar for each thinking type (ranging from $n = 54$ to $n = 77$) and therefore there were no systematic biases that would effect that interpretation of findings.

For an analysis of both sections of the questionnaire, a discussion of each set of findings will be communicated alongside the presentation of the results. This is to allow implications to be drawn out on the wide range of concepts analysed as they arise.

4.3.1 Perceptions of Effective Thinking and Collaborative Learning

When asked to define ‘effective thinking’, 43% of respondents defined it as ‘thinking ability’, 36% of practitioners responded within the category ‘knowledge’, 7% of teachers’ answers fell into the category ‘good citizen’, and 14% of teachers surveyed did not know how to define effective thinking (see Figure 4.1). These percentages, whilst perhaps disappointing, are not unexpected as often in classrooms teachers direct learners to ‘think harder’ but do not often qualify this command with advice on

how this can be done. These findings perhaps suggest that not all teachers are entirely sure of the cognitive processes involved with ‘good thinking’.

Figure 4.1: Percentage of teachers defining ‘Effective Thinking’ within the categories of ‘thinking ability’, ‘knowledge’, ‘good citizen’ and ‘don’t know’

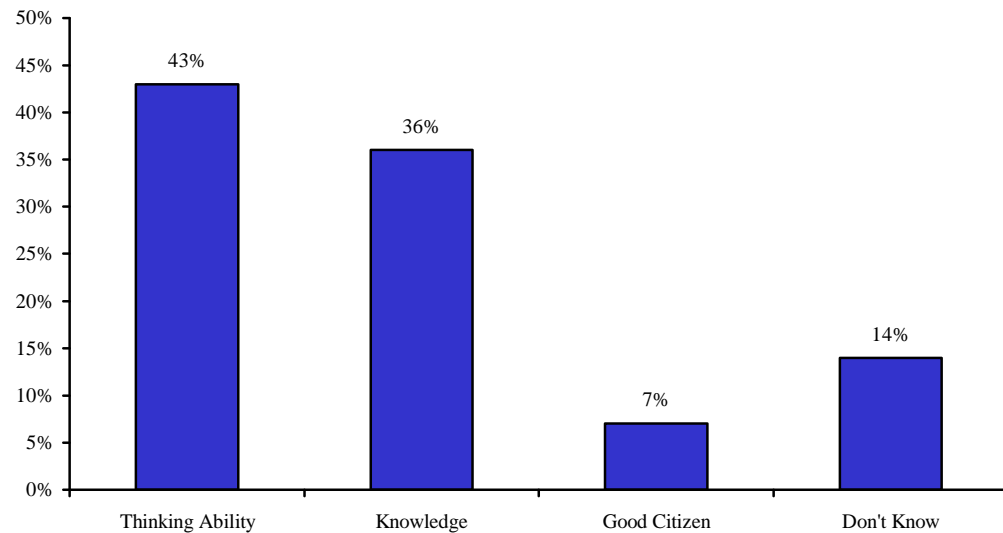
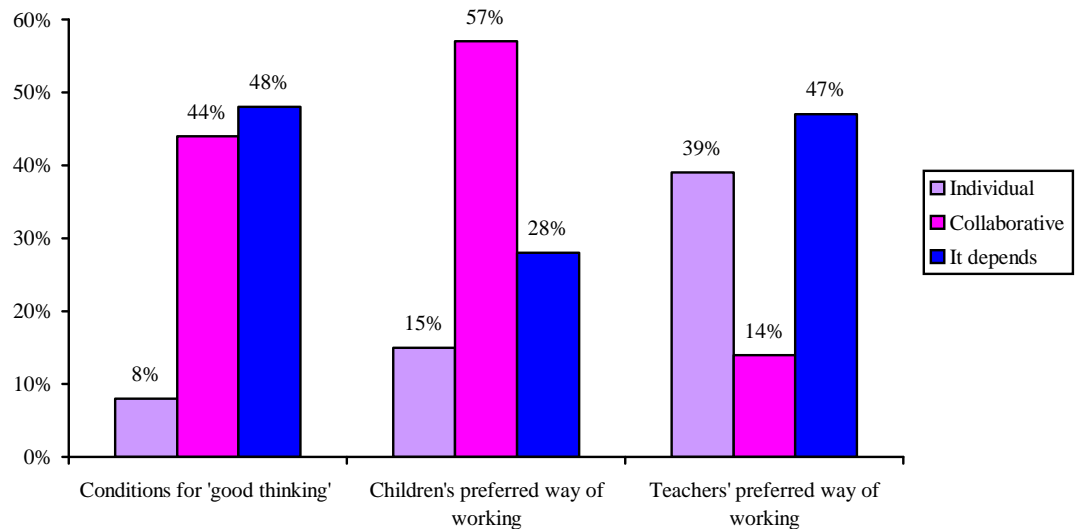


Figure 4.2 displays the response categories regarding teachers’ beliefs about collaborative learning. As can be seen, in response to the question about how children think best, 48% of practitioners stated that it would depend on the individual children involved and the tasks requested of the children. This was closely followed by 44% of teachers who believed that collaborative learning is more beneficial to help children think, than those who believed individual learning is more effective (8%).

Figure 4.2: Percentage of teachers responding within the categories of ‘individual’, ‘collaborative’ and ‘it depends’ regarding the best way to foster effective thinking, children’s preferred way of working and teachers’ preferred way of working



More than half of teachers surveyed (57%) believed that children preferred to work collaboratively, but 28% of practitioners thought that this would be child and context specific (i.e., 28% cited ‘it depends’). Only 15% of practitioners believed that children preferred to work individually. For the final qualitative question in the first section of the questionnaire, the majority of teachers (47%) stated that their preference for either collaborative or individual learning would depend on the pupils, the task, and the context. A lesser number of teachers (39%) stated that they preferred children to work individually, with only 14% of teachers preferring to have children work collaboratively.

The findings from the responses given to these last three questions associated with collaborative learning imply that teachers are aware that there are some conditions and situations that are not conducive to a successful outcome from collaborative learning. In this respect, therefore, these findings provide further confirmation that more research is needed into the factors associated with the effectiveness of collaborative learning (Messer & Pine, 2000). An interesting finding from the above

questions comes from an amalgamation of responses to all three questions to do with collaborative learning; whilst 44% of teachers surveyed believed that collaborative learning is most effective at developing children's ability to think, and more than half of the teachers (57%) were shown to believe that children prefer to work collaboratively, a comparatively small proportion of teacher (only 14%) of teachers surveyed cited that they actually *preferred* to provide opportunities for collaborative learning. This could suggest that other factors (for example the noise level, classroom dynamics, time involved) are deterring practitioners from providing more opportunities to incorporate collaborative learning into daily classroom practices. It also implies that, if children do prefer to work collaboratively, this could impact on their task motivation.

4.3.2 Thinking Types across the Curriculum

Table 4.1 illustrates that, overall, teachers perceive critical thinking skills to be taught most frequently within the curriculum ($M = 239.61$), and learners of all ages to be exposed least to problem solving skills ($M = 132.17$). However, this figure concerning problem solving is perhaps misleading, as, within the 5 – 14 curricular guidelines, problem solving is explicitly promoted within only the context of mathematics, with set strategies (such as 'work backwards' and 'act out the situation') detailed. This encourages practitioners to isolate problem solving as a sub-set of skills through which mathematics can be taught. The benefits of encouraging learners to problem-solve and problem-find within all curricular areas therefore needs to be raised, so that any challenge with which the children are faced (for example working out how to structure an essay, or how to use musical instruments to create a prescribed atmosphere) is viewed as problem solving.

Table 4.1: Mean scores of thinking types

	N	Minimum	Maximum	Mean	Std. Deviation	Thinking Type Mean Skills Scores
Total Searching for meaning	63	109	375	229.29	54.51	32.7
Total Critical Thinking	54	103	382	239.6	64.50	29.88
Total Creative Thinking	62	50	236	155.68	35.36	38.92
Total Problem Solving	60	53	219	132.18	33.14	33.05
Total Decision Making	59	98	360	208.97	60.31	34.83
Total Metacognition	58	48	197	138.95	39.68	34.73
Valid N (listwise)	37					

However, whilst the column entitled “Mean” in the table above suggests the average amount that teachers perceive the thinking types are taught within the curriculum overall, to compensate for the fact that some of the thinking types have more thinking skills in them than others, the last column in Table 4.1 was created. To derive these scores, the overall mean score was divided by the number of skills within each thinking type. The resulting scores show the mean amount of times teachers report teaching individual skills within that thinking type. As there are different numbers of thinking skills within the thinking types, the means in the last column therefore do not reflect the overall means of each thinking type. For instance, as mentioned in the previous paragraph, the thinking type that teachers perceived to be taught most frequently was critical thinking ($M = 239.6$). However, an analysis of the broken down mean scores in the final column indicates the highest mean score for individual creative thinking skills ($M = 38.92$). The reason for this difference is because there are eight critical thinking skills being taught, compared to only four creative thinking skills. Therefore, as there are fewer numbers of composite thinking skills within the category of ‘creative thinking’, overall the thinking type of creative thinking is taught to a lesser degree. Similarly, critical thinking overall is taught the most frequently as, although each of the eight skills is taught less often than the other skills ($M = 29.88$), there are more critical thinking skills to teach, which results in the thinking type being most frequently taught overall.

4.3.3 Frequently Taught Thinking Skills within Thinking Types

Table 4.2 shows that within the thinking type of searching for meaning, teachers perceive the thinking skill, ‘finding similarities and differences’ to be taught most frequently within the curriculum ($M = 38.12$), and the skill ‘parts and wholes’ to be taught least frequently ($M = 24.65$). One possible reason for this finding, however, is that respondents did not fully understand that term ‘parts and wholes’, as it is not a term used with much frequency within the current curricular guidelines in Scotland. It should be noted, however, that teachers may still be promoting this skill, but more indirectly and not using the official skill name.

Table 4.2: Mean scores of skills within the category of searching for meaning

	N	Minimum	Maximum	Mean	Std. Deviation
Sequencing	77	18	51	31.05	7.37
Classifying	75	18	53	32.04	7.54
Analysing	75	12	58	33.2	10.33
Parts & Wholes	68	12	56	24.65	10.46
Similarities & Differences	76	14	60	38.12	8.13
Comparing & Contrasting	77	13	60	37.42	8.84
Patterns & Relationships	77	14	55	33.40	8.48
Valid N (listwise)	63				

Within creative thinking skills, Table 4.3 suggests that practitioners understand ‘formulating own points of view’ as occurring most frequently within the curriculum ($M = 42.71$), and the skill of ‘taking multiple perspectives’ as being promoted least often ($M = 36.95$). It is perhaps surprising that respondents did not perceive the thinking skill of ‘generating ideas’ as the most frequently taught skill within creative thinking since most activities involve learners in thinking up ideas of some sort (e.g., Swartz & Parks, 1994). Furthermore, many of the other thinking types (specifically decision making and problem solving), involve the learner using the skill ‘generating ideas’ before good decisions can be made and problems can be solved skilfully.

Table 4.3: Mean scores of skills within the category of creative thinking skills

	N	Minimum	Maximum	Mean	Std. Deviation
Generating Ideas	64	12	60	40.48	9.33
Combining Ideas	64	12	60	39.41	9.60
Own Points of View	62	14	65	42.71	9.85
Taking Multiple Perspectives	63	13	60	36.95	10.06
Valid N (listwise)	62				

Teachers believe that within critical thinking, the thinking skills ‘drawing conclusions’ ($M = 35.62$) and ‘giving reasons’ ($M = 35.72$) are promoted most regularly within the curriculum, as shown in Table 4.4. ‘Designing a Fair Test’ and ‘Determining Bias’ are reported as being taught the least often ($M = 24.28$, $M = 24.28$ respectively). Although the data suggests that practitioners frequently ask children to ‘give reasons’ for their answers, this skill is also about ‘finding reasons’ and looking critically at data, a skill which perhaps needs to be promoted amongst children.

Table 4.4: Mean scores of skills within the category of critical thinking skills

	N	Minimum	Maximum	Mean	Std. Deviation
Predictions & Hypotheses	75	12	53	32.21	8.80
Drawing Conclusions	76	12	60	35.62	9.45
Giving Reasons	76	17	55	35.72	9.43
Fact or Opinion	71	12	48	29.21	8.94
Determining Bias	61	12	49	24.28	9.97
Reliability Evidence	63	12	52	27.54	10.49
Cause & Effect	63	12	60	32.87	10.97
Designing Fair Test	65	13	52	24.28	9.81
Valid N (listwise)	54				

Table 4.5 illustrates teachers’ perception of the frequency with which individual skills are taught within problem solving. ‘Clarifying situations’ ($M = 35.76$) and ‘generating solutions’ ($M = 35.60$) are focused on most regularly, and ‘evaluating

solutions' ($M = 29.76$) given the least amount of attention. This suggests that once practitioners have encouraged children to do the first two steps within a problem solving strategy (that is, identifying the problem and thinking up possible solution strategies), that an equal amount of time also needs to be given to encouraging children to see the value of selecting a solution strategy, listing the steps involved in their strategy, and then, crucially, evaluating whether their solution has worked or not. Learners will only be able to solve problems effectively if they are adept at all stages involved (e.g., Kirkwood, 2005; Polya, 2004; Swartz & Parks, 1994).

Table 4.5: Mean scores of skills within the category of problem solving

	N	Minimum	Maximum	Mean	Std. Deviation
Clarifying Situations	63	12	60	35.76	9.71
Generating Solutions	64	12	60	35.59	9.90
Implementing Strategies	62	12	56	32.85	8.82
Evaluating Solutions	63	12	56	29.76	10.74
Valid N (listwise)	60				

Within the thinking category of decision making, respondents feel that in the curriculum children are given the most amount of time to practise the skill of 'predicting consequences' ($M = 36.30$), and least opportunity to 'identify why a decision is necessary' ($M = 32.78$) (see Table 4.6). Yet whilst opportunities were provided for children to predict the consequences, in comparison, children were less frequently encouraged to 'review consequences' ($M = 34.30$). In this respect this finding is similar to the above point regarding problem solving; that is, once a decision has been made or once a strategy has been selected to solve a problem, it is extremely important that learners then reflect on how successful their thinking strategy has been (Perkins, Goodrich, Tishman, & Owen, 1994).

Table 4.6: Mean scores of skills within the category of decision making

	N	Minimum	Maximum	Mean	Std. Deviation
Identifying why dec nec	61	12	60	32.77	11.60
Generating Options	62	12	60	35.69	11.11
Predicting Consequences	61	18	60	36.30	9.40
Pros & Cons	61	12	60	35.25	10.08
Deciding Course of Action	61	13	60	35.21	9.94
Reviewing Consequences	60	14	60	34.30	10.96
Valid N (listwise)	59				

As discussed in Chapter 1, developing children's metacognitive awareness is known to be crucial in enhancing general thinking skill ability (Beyer, 1987, 1997; Fisher, 2003; Grotzer & Perkins, 2000). Table 4.7 shows that teachers are providing opportunities for children to develop these skills, particularly encouraging children to 'redirect' their thinking ($M = 36.56$), closely followed by opportunities to 'evaluate' thinking ($M = 36.03$). These data appear to suggest that learners are encouraged less frequently to 'monitor' their thinking ($M = 31.36$). Yet it is possible that many of these metacognitive opportunities are teacher-led. The 5 – 14 curricular documents explicitly advise teachers to instigate children's attempts at planning their work, and many practitioners plan tasks with the class as a single entity. Similarly, opportunities for evaluation at the end of a piece of work are often encouraged by the teacher prompting children to check their work. In this respect, evaluation is covered only in a superficial way, and often it is not the actual thinking that is being evaluated, but neatness of writing and basic errors. It is possible that learners are not becoming fully self-regulated as they are not thinking about their thinking, but thinking about the presentation of their work. Developing learners who are metacognitively aware at all core stages of a task (i.e. before, during and after) is a fundamental prerequisite for developing all other cognitive skills. These aforementioned three key stages involved in metacognitive thought are widely accepted to represent the essence of metacognition and therefore need to be explored in classrooms in much more depth (e.g., Beyer, 1987; Costa, 2001). For this to happen effectively, teachers need to be given explicit training in each of the key

areas of metacognition so that they can foster children's metacognition within a variety of contexts and are aware of strategies, key questions and prompts to help children become more self-regulated learners.

Table 4.7: Mean scores of skills within the category of metacognition

	N	Minimum	Maximum	Mean	Std. Deviation
Planning	61	12	60	34.15	10.84
Monitoring	61	12	59	31.36	12.30
Redirecting	62	12	57	36.56	10.97
Evaluating	62	12	59	36.03	12.07
Valid N (listwise)	58				

4.3.4 Frequency of Thinking Skills Taught within Individual Curricular Areas

In Table 4.8 it can be seen that teachers report that thinking skills are taught most often within the subject areas of science ($M = 109.73$) and technology ($M = 107.08$), and least frequently within music lessons ($M = 72.20$). However, these findings need to be treated with some caution. It is possible that teachers associate thinking skills with science as it is an inquiry-oriented subject where they regularly ask children to conclude, make predictions, generate ideas and hypotheses. Furthermore, teachers commonly follow prescriptive resources to teach these lessons and the lesson plans frequently specify these types of thinking. Although these data would appear to suggest that thinking skills are least frequently taught in three of the expressive arts subjects (music, physical education, $M = 78.66$; art and design, $M = 79.49$), it is possible that teachers are not aware of the thinking skills being taught by specialist teachers. Alternatively, the class teachers may be less confident in introducing thinking skills into these areas as they do not teach the subjects regularly. They may be more concerned with transmitting the subject's content knowledge rather than focusing on explicitly teaching thinking skills.

Table 4.8: Total mean scores for thinking skills within curricular areas

	N	Minimum	Maximum	Mean	Std. Deviation
Thinking skills in English	48	43	157	100.56	22.54
Thinking skills in maths	51	35	145	99.71	22.18
Thinking skills in science	51	62	158	109.73	21.26
Thinking skills in technology	49	43	157	107.08	23.27
Thinking skills in social subjects	48	47	155	99.92	21.29
Thinking skills in RME	49	37	143	85.78	23.82
Thinking skills in PSD	48	60	156	98.77	22.15
Thinking skills in health	48	43	141	93.50	23.38
Thinking skills in music	46	33	125	72.20	23.95
Thinking skills in drama	46	36	142	85.89	24.68
Thinking skills in PE	47	34	142	78.66	24.62
Thinking skills in A&D	45	36	142	79.49	24.38
Valid N (listwise)	37				

4.3.5 Developmental Trends in Teaching Thinking Skills

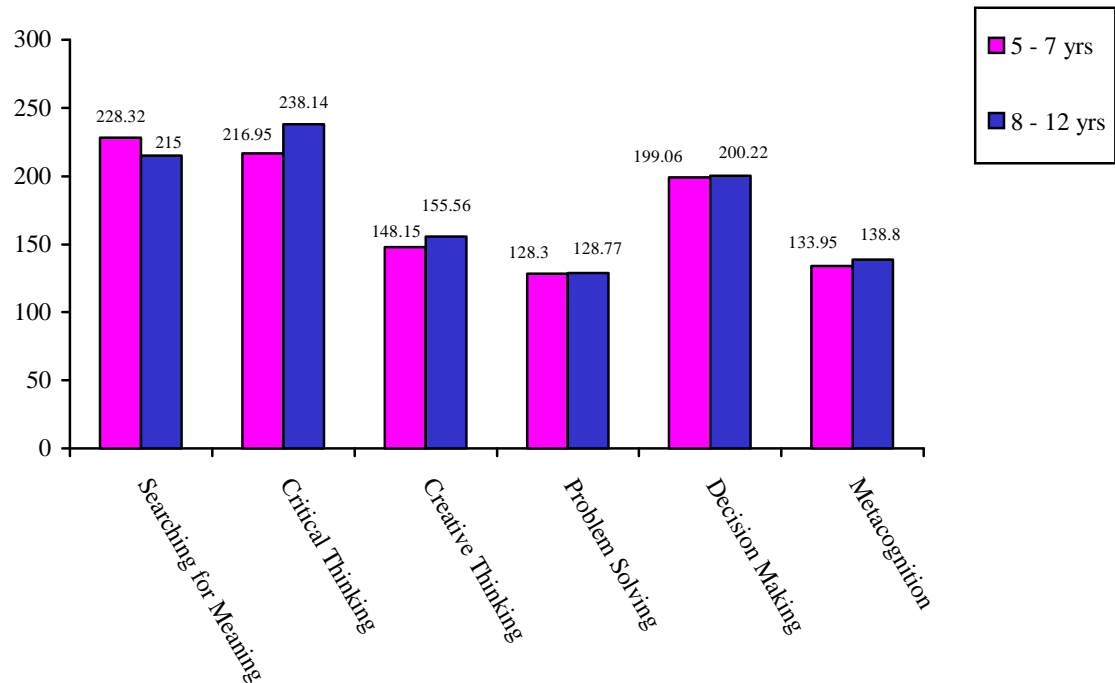
Independent-samples t-tests were conducted to compare the scores of the various thinking types for age group 1 (5 – 7 yrs) and age group 2 (8 – 12 yrs). The results for each thinking type are presented below (also see Figure 4.3):

Searching for Meaning: There was no significant difference in the mean scores for age group 1 ($M = 228.32$, $SD = 66.93$), and age group 2 ($M = 215.00$, $SD = 40.27$; $t(25.88) = .79$). This could be a reflection that the thinking skills within this category (e.g., sequencing, sorting, noting similarities and differences) are ones which children are exposed to from an early age, and ones that are used regularly within all curricular areas and from early years to upper primary (e.g., Scottish Office Education Department, 1991a; 1991b).

Critical Thinking: T-tests revealed no significant age difference in overall critical thinking: group 1 ($M = 216.96$, $SD = 74.26$); group 2 ($M = 238.14$, $SD = 40.52$; $t(45) = -1.14$). This result is somewhat unexpected because age-related trends might have

been anticipated as some of the higher order thinking skills (e.g. ‘determining bias’, ‘relating cause and effect’) would be too complex to be taught to children in the early years of primary school.

Figure 4.3: Mean Scores of age group 1 and age group 2 analysed to show developmental trends



Creative Thinking: As with the previous two categories, there was no significant age difference in creative thinking skills: age group 1 ($M = 148.15$, $SD = 42.46$); age group 2 ($M = 155.56$, $SD = 30.14$; $t(50) = -.74$). When one of the most important skills within creative thinking is considered (i.e., generating ideas), the lack of a developmental trend is not unexpected, as children at all ages and stages and in all curricular areas are encouraged to think up ideas. However, as the thinking type of creative thinking also included other slightly more complex skills, such as ‘taking multiple perspectives’ and ‘seeing other points of view’, it is unfortunate that more opportunities were not provided for older children to practise these skills, as they would perhaps find it easier than younger children.

Problem Solving: There were no significant differences when the scores of group 1 ($M = 128.30$, $SD = 41.72$) and group 2 ($M = 128.77$, $SD = 27.61$; $t(29.75) = -.05$) were compared. Although problem solving is mentioned explicitly in the mathematics curricular guidelines, the discussion of progression within the problem solving section does not include specific targets for each level. Whilst this could be an indication that practitioners would have preferred more concrete examples of problem solving at different levels to help them teach it appropriately for age, it must be remembered that this category of problem solving refers to all curricular areas, not just mathematics.

Decision Making: There was no significant age difference between the scores of group 1 ($M = 199.06$, $SD = 62.49$) and group 2 ($M = 200.22$, $SD = 51.60$; $t(48) = -.07$). Whilst young children have some involvement in making decisions in school, older children are given more responsibility to make appropriate decisions. It might have been expected then that these data would suggest a progression whereby older children are involved in making good decisions, predicting consequences, weighing up pros and cons and reviewing consequences.

Metacognition: No significant difference emerged between the way teachers of children in early years (group 1, $M = 138.80$, $SD = 39.60$) and teachers of middle – upper primary children (group 2, $M = 138.80$, $SD = 39.60$; $t(47) = -.40$) reported teaching metacognitive skills. This finding is unexpected as there is a body of research that suggests that metacognitive abilities increase with cognitive abilities (Larkin, 2002). By that rationale, it would be predicted that there would be significantly more opportunities provided for older children (8 – 12yrs) to develop their metacognitive skills. If teachers are attuned to their children's development then they should mirror age changes in their teaching methods. Teachers need to be supported through training and resources to encourage them to further their developmentally appropriate teaching methodologies incorporating thinking skills at relevant stages in the primary curriculum. This would allow children to experience continuity, progression and depth of thinking skills throughout the curriculum.

Whilst this study has revealed a range of interesting trends in teachers' perceptions of thinking skills, there are a number of methodological limitations that should be acknowledged. For instance, it is important that practitioners are given time within School Improvement Plans to reflect on and complete official audits. This would mean that audits received would have less missing data. For example, it is possible that teachers may have misunderstood terms such as 'parts and wholes' and 'monitoring thinking'. A similar problem was discovered in a study by Paul, Elder and Bartell where few teachers were able to differentiate between an 'assumption' and an 'inference' for example (2004). Furthermore, teachers may have associated specific thinking skills with specific subjects such as science. These factors may have biased their responding. The questionnaire approach does not allow one to examine the reasoning behind their responses. Future research would benefit from taking a range of methodological approaches including qualitative interviews and focus groups. Qualitative approaches would allow one to explore in detail teachers' understandings and perceptions of thinking skills and how they can be implemented in the classroom.

4.4 Conclusions

Chapters 1 and 3 presented in the introductory chapters to this thesis highlighted the current emphasis within education to develop effective thinkers. However, Chapter 2 discussed the lack of data on teachers' and pupils' views regarding what it means to think effectively. The purpose of this study was therefore to gather baseline data on teachers' concepts of effective thinking, their preferences for fostering collaborative learning within their classrooms, and the frequency with which practitioners believe they are teaching thinking skills throughout the curricular areas. The results suggest that teachers' concepts of the core elements involved with effective thinking need to be deepened. This finding has particular relevance for the third study of this thesis; practitioners cannot raise children's awareness of the skills, strategies and dispositions associated with 'good thinking' if they are not aware of them themselves. Furthermore, if Wegerif's (2000) and Gokhale's (1995) view is accepted, that collaborative learning enhances children's thinking skills, then practitioners need support to ensure they are aware of the benefits of incorporating

collaborative learning into daily classroom practices. These findings therefore imply that in-depth staff training will be central to the success of interventions conducted within educational environments.

The data gathered from this study highlighted that thinking skills are integrated more successfully into some areas of the curriculum than others. Therefore, teachers' awareness needs to be raised of how thinking skills can be infused into all curricular areas. This finding also provides important baseline information for the intervention study presented in this thesis. These data also suggest that more emphasis in classrooms needs to be placed on encouraging learners to think about their thinking, with an aim to improving their metacognitive abilities. In light of this finding, Study 3 trained teachers specifically on how to ensure opportunities are provided within lessons to develop children's metacognition.

The data also suggests that children need to be given explicit practise at using a wide range of thinking skills within each broad thinking type. However, not all thinking skills are appropriate for use in all contexts, situations and subject areas, and for this reason teachers also need to provide children with opportunities to select and employ situation-specific thinking skills in a variety of contexts.

This study has highlighted that teachers believe they are already providing opportunities for children to become familiar with thinking skills and, in Scotland, have been supported to a certain extent through the 5 – 14 guidelines. However, contrary to expectation, children in upper primary were not exposed more frequently to complex thinking skills than children in early primary. This is interesting given developmental evidence that older children are more able to engage in some of these thinking skills. If it is widely accepted that it is more beneficial to infuse thinking skills into the curriculum rather than teaching thinking skills discretely, future interventions should support primary practitioners with the task of embedding thinking skills into all curricular areas effectively. Moreover, guidance is needed to encourage practitioners to tailor the level of integration of those thinking skills with the development of their class, perhaps through the use of explicit age-appropriate

thinking skill frameworks. The findings support Beyer's view discussed in Chapter 1 that more support needs to be given to ensure practitioners are teaching a clear progression of thinking skills (1987). This will be discussed further in the final chapter of this thesis in relation to policy and practice.

A note of caution must be made about these findings in general, however. This study has analysed teachers' beliefs about the extent to which they foster thinking skills within the curriculum. However, depending on how explicitly thinking skills are taught, and whether they are being taught age-appropriately, there may be no correlation between teachers' perceptions and children's actual knowledge of thinking skills. For this reason, a study of children's concepts of what it means to be a 'good thinker' and their understandings of individual thinking skills is another important step prior to intervening to enhance children's thinking skills. Study 2, reported in the following chapter, therefore presents baseline data on children's concepts of effective thinking and intelligence and their knowledge of thinking skills. Like previous studies in this area, it analyses potential developmental trends by examining the data from 5, 7, and 11 year-old children. Study 3 (presented in Chapters 6 and 7) builds on the baseline findings gathered from the first two studies in this thesis through a structured intervention. The intervention will encourage practitioners to teach appropriate age-relevant thinking skills and to develop practitioners' ability to integrate thinking skills into all areas of the curriculum explicitly.

CHAPTER 5

STUDY 2: DEVELOPMENTAL CHANGES IN CHILDREN'S CONCEPTIONS OF THINKING SKILLS AND INTELLIGENCE²

5.1 Aims of this Chapter

In the previous chapter, Study 1 highlighted that teachers are unsure of what constitutes effective thinking, and the data gathered appeared to suggest that teachers do not appear to be mirroring developmental changes through their teaching of thinking skills. The lack of coherent age-specific frameworks to promote attributes of effective thinking within learning environments (see Chapter 1 for a discussion), is one possible reason for this. Study 1 also revealed, however, that practitioners believe that they are teaching thinking skills within the curriculum. This study will examine whether children are aware of the thinking skills teachers believe are being taught. Chapter 2 highlighted the lack of research on how children understand the phenomenon of effective thinking. Furthermore, although a variety of research has been conducted into children's concepts of intelligence in other parts of the world, few studies have gathered comparative data on children's concepts in the U.K. This chapter aims to identify children's concepts of effective thinking and intelligence, and to detect any developmental trends in these understandings. This chapter will also investigate the correlation between children's understandings of effective thinking and intelligence to establish if children are aware of the thinking processes they can employ to enhance their intelligence. In addition to contributing to the

² Data from this study is in press in *Early Child Development and Care* (see Appendix F) and has been presented at the British Psychological Society Conference, September 2005, the Scottish Educational Research Association 2005th annual conference, and Falkirk Council's *Learning to Achieve* 2006th annual conference.

literature on theories about children's cognitive development, the findings from this study will therefore provide important baseline information for Study 3, which will attempt to enhance children's thinking skills.

5.1.1 A Summary of Children's Conceptions of Intelligence

Chapter 2 demonstrated that recently children's conceptions of intelligence have been researched with increasing interest, particularly in relation to children's definitions of intelligence and the characteristics and causes associated with the concept (e.g., Kurtz-Costes et al., 2005; Yussen & Kane, 1985). Dweck's work (e.g., 1999) was also presented which argues that children may view intelligence either as a fixed trait (entity view) or alternatively as open to change through effort (incremental view). She found that these views regarding the stability of intelligence guided both the way in which children approached tasks and also their motivation to achieve (see also Stipek & Gralinski, 1996). These findings have clear implications for educational interventions.

These key themes within the research literature on children's concepts of intelligence have typically considered the extent to which developmental changes are evident (Cain & Dweck, 1995; Dweck, 1999; Kinlaw & Kurtz-Costes, 2003; Kurtz-Costes et al., 2005; Stipek & MacIver, 1989; Yussen & Kane, 1985). Whereas younger children have been found to associate intelligence primarily with social skills and other non-cognitive abilities (Heyman, Gee, & Giles, 2003; Kurtz-Costes et al., 2005; Stipek & Tannatt, 1984), by contrast, older children conceptualise intelligence mainly in terms of cognitive ability and knowledge (Kinlaw & Kurtz-Costes, 2003; Kurtz-Costes et al., 2005; Yussen & Kane, 1985). Chapter 2 also indicated that many theorists believe that, with age, children are more likely to view a negative relationship between effort and ability (Covington, 1983; Droege & Stipek, 1993; Heyman et al., 2003; Kurtz-Costes et al., 2005). Furthermore, although the findings are contradictory, some studies have found that, with age, children are also more likely to view intelligence as a stable trait (Dweck & Bempechat, 1983; Kurtz-Costes et al., 2005; Stipek & Daniels, 1988; Stipek & MacIver, 1989).

This study will gather comparative data on these issues. If the findings gathered in this study support previous research cited above and in Chapter 2, it is predicted that younger children will define intelligence in cognitive and non-cognitive terms but with age there will be a trend towards children conceptualising intelligence mainly in terms of cognitive abilities. Similarly, that an age trend in responses will be highlighted regarding the relation between intelligence and effort and the stability of intelligence with older children responding that intelligence is more stable and less likely to be improved with effort. However, despite the focus on understanding children's concepts of intelligence, few studies have related children's views of intelligence to their views of effective thinking. This study will also explore the link between children's views of intelligence and their views of effective thinking. Gathering baseline data on children's concepts of intelligence and effective thinking will have important implications for the success of classroom interventions, particularly as some theorists believe that children's concepts affect their effort and perseverance on challenging tasks. Furthermore, collecting baseline data on children's beliefs will produce valuable data on whether children are aware of *how* to become more intelligent (i.e., what makes them more intelligent) and how to improve their thinking ability.

5.1.2 A Summary of Children's Conceptions of Effective Thinking

Past research has therefore tended to concentrate on identifying children's concepts of intelligence. Despite the fact that the teaching of thinking skills is now widely promoted in schools (see Chapter 3 for an overview of programmes), there have been no similar studies of children's concepts of thinking skills or effective thinking. Gathering data on children's concepts of what it means to be an effective thinker is necessary. If children view effective thinking in similar terms to intelligence, it is predicted that younger children will define effective thinking in both cognitive and non-cognitive terms but with age there will be a trend towards children conceptualising effective thinking primarily as a cognitive ability. Similarly, it is not yet known whether learners incorporate thinking skills into their definitions of both intelligence and effective thinking. It is possible that there will be a strong

correlation between children's responses to questions about intelligence and effective thinking as both sets of concepts will follow similar developmental pathways.

Another fundamental gap in existing literature on thinking skills is the lack of research on children's concepts of thinking skills. Yet given the research on the importance of children's concepts of intelligence for their own learning, it would seem essential for any endeavour to enhance thinking skills among children to consider what children's conceptions of these skills might be and how they develop with age. Data from Study 1 suggested that, whilst teachers generally appeared to be teaching thinking skills, the skills taught may not be tailored to their pupils' cognitive development. A focus for this study will be to discover children's knowledge of thinking skills and whether there is a developmental progression relating to children's understandings of specific thinking skills. It is anticipated that with age children will develop more refined and accurate concepts of individual thinking skills.

Discovering this baseline data will highlight important implications for the intervention study presented in this thesis. For example, as children are often encouraged in classrooms to 'think harder' and praise is given by teachers for 'good thinking', understanding children's views of what it means to be a 'good thinker' will reveal whether they are aware of the cognitive processes to apply when instructed to think 'harder' or 'better'. Similarly, a lot of research has been gathered on children's concepts of what it means to be 'clever', with findings indicating that, with age, children are increasingly likely to view 'cleverness' cognitively and relate the concept frequently to knowledge acquisition. Comparative data is needed to discover if children hold similar beliefs about effective thinking. The focus of the present study is therefore to examine children's concepts of intelligence and to explore for the first time children's understanding of specific thinking skills.

5.1.3 The Present Study

This exploratory study examines the development of primary school children's understandings of effective thinking, intelligence and their knowledge about specific thinking skills. The main research questions are:

- Are there developmental changes in the way children define intelligence and effective thinking?
- Are there developmental trends concerning children's knowledge of individual thinking skills?
- Is there a relation between children's views of intelligence and effective thinking?

5.2 Method

5.2.1 Participants

In total seventy-five children participated in this study with 25 children from each of the following ages: primary one ($M = 5, 5$; $range = 5, 1$ to $6, 0$; 10 boys, 15 girls) primary three ($M = 7, 4$; $range = 7, 0$ to $7, 9$; 13 boys, 12 girls) and primary seven ($M = 11, 5$; $range = 11, 0$ to $11, 9$; 10 boys, 15 girls). Participants were recruited from four primary schools in central Scotland including a broad spectrum in terms of socio-economic status. Parental and pupil consent was obtained for all participants.

5.2.2 Materials and Procedures

Each child was interviewed individually in a school setting. The interviewer explained to each child that the purpose of the study was to understand what children think about being 'clever' and being 'a good thinker'. The interviews lasted an average of 15 minutes and were tape-recorded for later transcription and coding.

In Study 1, a questionnaire-based approach was used to elicit data from the relatively large sample of teachers. However, a similar approach was deemed inappropriate to gather data from children in this study, mainly because the younger children (and less able older respondents) involved would be restricted by their written language

ability. A semi-structured interview schedule was therefore devised. The basic format was based on published research on children's intelligence concepts (e.g., Cain & Dweck, 1995; Dweck, 1999; Kinlaw & Kurtz-Costes, 2003; Kurtz-Costes et al., 2005; Stipek & Daniels, 1988; Yussen & Kane, 1985). Draft interview schedules were extensively piloted and changes to the wording of published questions were made so that they were suitable for the UK context. For example, children in this study did not respond well to the word 'smart', the term used to define intelligence in USA studies so the UK alternative 'clever' was used in the interview. Questions relating to effective thinking used the term 'good thinking' a phrase familiar to children and frequently used in schools (e.g., Pithers & Soden, 2000).

The interview schedule included 21 questions and standardised prompts that were asked in a fixed sequence (see Figure 5.2). Some of the interview questions were in the form of vignettes and were accompanied by photographs. These photographs were created specifically for the study and illustrated children participating in cognitive tasks in a classroom setting (see Figure 5.1).

Figure 5.1: Examples of photographs used to accompany the interview vignettes



Several studies to document age-related increases in children's definitions of intelligence elicited the information by direct interview questions, such as "What does it mean to be smart/intelligent?" (Kurtz-Costes et al., 2005; Yussen & Kane, 1985) and "What does it mean to be smart in your schoolwork?", (Cain & Dweck, 1995). To detect if there is a developmental trend in children's views of the characteristics of intelligence (Yussen and Kane call this the 'visible signs' of intelligence), questions asked historically include, "If you meet a person, how do you know if he/she is smart?", "Does a smart person act differently or do anything differently than an average person?" (Yussen & Kane, 1985) and "How do you know if somebody's smart?" (Kurtz-Costes et al., 2005). Other questions asked, designed to probe children's understanding of the causes of intelligence, include "If a person is very smart, is it because of the things he/she has done or experiences he/she has had?", "What [else] causes people to be smart?" (Yussen & Kane, 1985). For the purposes of this study, children were initially asked a series of questions to explore their definitions of intelligence. They were asked to define intelligence ("What does it mean to be clever?"), to describe the characteristics of intelligence ("How do you know if someone is clever?"); to describe the causes of intelligence ("What makes someone clever?").

Typical questions asked by theorists to gain information on children's views of the relationship between effort and ability, include "Do smart kids work hard at school?", "Do kids who aren't very smart work hard?", "Who works the hardest at their schoolwork: children who are smart or children who aren't smart?" (Kurtz-Costes et al., 2005). For this study, to explore the relation between effort and intelligence in the Scottish context, two questions were asked ("Do clever children work hard at school?" and "Do children who aren't very clever work hard at school?").

Several studies have researched children's conceptions of the stability of intelligence, often by incorporating questions such as "Will a person always be the same in how smart he/she is or can he/she change?", "If someone is smart as a child, can he/she be not so smart when he/she grows up?", "If someone is not so smart as a child, can

he/she be smart when he/she grows up?” (Yussen & Kane, 1985) and “If you’re not very smart, can you change to get smarter?” (Kurtz-Costes et al. 2005). Other studies have asked children to rate their own and their classmate’s ability/competence now and in the future (e.g., “Tell me the names of your best friends. Okay, now of those friends, who is the smartest?” (Kurtz-Costes et al., 2005; Stipek & Daniels, 1988; Yussen & Kane, 1985). In this study, two questions were employed to examine whether children viewed intelligence as a stable characteristic over time (“If someone is clever, will they always be clever?” and “If someone is not clever, can they change to get cleverer?”).

Children were then asked to define effective thinking (“What does it mean to a good thinker?”), to describe the characteristics of effective thinking (e.g. “How do you know if someone is a good thinker?”); to describe the causes of effective thinking (“What makes someone a good thinker?”).

A series of vignettes (and photographs) were also presented to children along with associated questions. Two focused on explaining different levels of ability/performance. The first ability vignette focused on a child performing well at school and asked children to consider why she performed well, whether she would perform well in other school subjects (i.e. whether performance would transfer to other areas) and whether her performance would be stable across age. The second ability vignette described a child who performed poorly. Children were asked to consider why he performed poorly, whether he would perform poorly in other school subjects (i.e. whether performance would transfer to other areas) and whether his performance would be stable across age. The wording of the two ability vignettes was equivalent in all essentials.

Finally, children were presented with five vignettes each describing a child engaging in a specific thinking skill. The thinking skills included in the interview were selected from the frameworks of Swartz & Parks (1994) and McGuinness (2003). One thinking skill was chosen from each of the five main thinking types outlined in the frameworks. Through extensive piloting on all three age groups, the terminology

and the individual skills chosen were: ‘sorting’ (from the category of searching for meaning), ‘explaining’ (a critical thinking skill), ‘thinking up ideas’ (a creative thinking skill), problem solving, and decision-making. Vignettes (and accompanying photographs) with the following structure were used: “This is a child who makes decisions carefully. What sorts of things do you think she will be good at?”

Figure 5.2: Pupils’ interview schedule

Interview Schedule
<p>1) What does it mean to be clever?</p> <p>2) How do you know if someone is clever?</p> <p>3) What makes someone clever?</p> <p>4) Do clever children work hard at school?</p> <p>5) Do children who aren’t very clever work hard at school?</p> <p>6) If someone is clever, will they always be clever?</p> <p>7) If someone is not clever, can they change to get cleverer?</p> <p>8) What does it mean to be a good thinker?</p> <p>9) How do you know if someone is a good thinker?</p> <p>10) What makes someone a good thinker?</p> <p>Ability Vignettes:</p> <p>This is a picture of Mary. Mary is getting a lot of her work right.</p> <p>11) Why do you think she keeps getting her work right?</p> <p>12) Will she get lots right in all of her school subjects?</p> <p>13) When she’s older, will she still get lots right in her schoolwork?</p> <p>This is picture of John. John is getting a lot of his work wrong.</p> <p>14) Why do you think he keeps getting his work wrong?</p> <p>15) Will he get lots wrong in all of his school subjects?</p> <p>16) When he’s older, will he still get lots wrong in his schoolwork?</p> <p>Thinking Skills Vignettes:</p> <p>17) This is a child who thinks up lots of ideas. What sorts of things do you think she will be good at?</p> <p>18) This is a child who is able to solve problems. What sorts of things do you think he will be good at?</p> <p>19) This is a child who is able to sort things into groups. What sorts of things do you think he will be good at?</p> <p>20) This is a child who is able to carefully make decisions. What sorts of things do you think she will be good at?</p> <p>21) This is a child who is able to explain what they are thinking. What sorts of things do you think he will be good at?</p>

5.2.3 Data Coding

To examine children's open-ended responses, as in Study 1, content analysis was employed to create coding schemes based on children's own responses. This coding procedure involved responses in a randomly selected sub-set of 30 interviews being coded by the interviewer and an independent blind coder. The inter-judge reliability score on individual interview questions for this sub-set of interviews was 100% for all questions except questions 1, 2, 9 and 14 which each had 88.9% agreement. The emergent coding schemes were subsequently used to code the whole data set. The majority of children only gave single responses, consequently the first response each child gave was coded and entered into the analysis.

The same coding scheme was derived from responses to the questions about definitions of intelligence, definitions of effective thinking and reasons for good/poor performance (i.e., questions 1, 2, 3, 8, 9, 10, 11, 14 – see Figure 5.2): miscellaneous; don't know; knowledge/achievement (e.g., "they put their hands up first", "they get all of the answers right"); effort (e.g., "they work hard", "they do all of their homework"); thinking ability (e.g., "they're good at making stuff up in their heads", "they think fast"); good citizen (e.g., "help people"; "listen to the teacher"; "they don't talk in class"); non-cognitive (e.g., "they can jump high", "they can stretch their hands out really far"); general cognitive ability (e.g., "they do neat work", "they can write their name properly"); and nurturing environment (e.g., "their parents help them"). Categories were collapsed for statistical analyses into 'cognitive' (categories 'knowledge/achievement', 'thinking ability' and 'general cognitive') or 'non-cognitive' (categories 'effort', 'good citizen' and 'non-cognitive'). The categories 'miscellaneous', 'don't know' and 'nurturing environment' occurred infrequently and were excluded from the analysis.

Questions concerning the relation between effort and ability, the stability of intelligence, and the generalisability of intelligence (i.e., questions 4, 5, 6, 7, 12, 13, 15, 16, see Figure 5.2) were initially coded 'yes', 'no' and 'maybe' in line with Kurtz-Costes et al. (2005). For subsequent analysis for all of the questions except one, the 'maybe' responses were recoded to 'no' to provide a dichotomous response

scale for analysis. ‘Miscellaneous’ responses and ‘don’t know’ responses were excluded from the analysis. As the item “Do children who are not clever work hard?” (question 5) was negatively worded, it was recoded so that the ‘maybe’ responses were reclassified with ‘yes’ responses.

Responses to the individual thinking skills vignettes were classified into: understanding of the thinking skill (e.g. problem solving, decision making, creative thinking etc.); general cognitive ability (e.g., “they’re good at maths”; “they can write their name”); general non-cognitive ability (e.g., “they look smart”; “they can stretch their hands far”); good citizen (e.g., “help people”; “listen to the teacher”; “they don’t talk in class”) and a miscellaneous category. For the purposes of analyses the categories were collapsed into two main categories: ‘understanding of thinking skill’ or ‘other’ (all other categories). The tables present the full set of data categories (in percentages) for each question to illustrate qualitatively the range of children’s responses at different ages. The statistical analyses are based on the reclassifications of the coding schemes to conform to the statistical requirements of the Chi-square test.

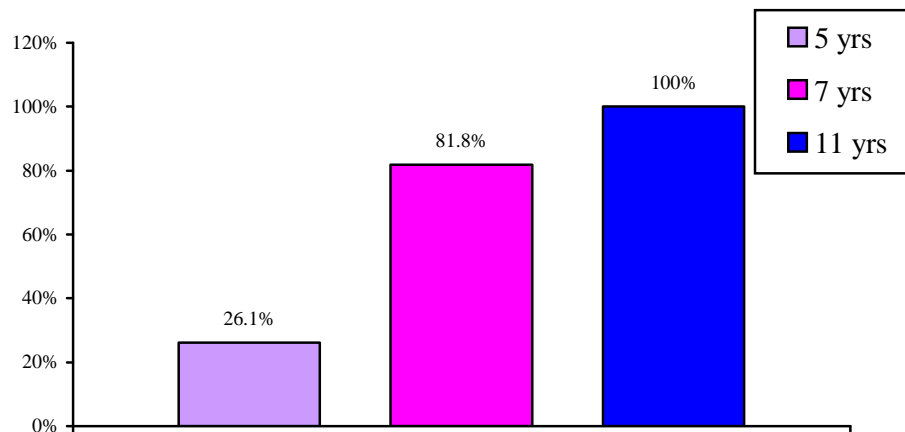
5.3 Results

Data were analysed using content analysis. Re-coded data were analysed using Chi-square statistics to reveal age trends in conceptual understandings of intelligence, effective thinking and specific thinking skills. No significant gender differences were found for any question.

5.3.1 Developmental Differences in Understandings of Intelligence

A statistically significant developmental trend was evident in responses to “What does it mean to be clever?” (see Figure 5.3, and Table 5.1. for the detailed response categories), with 73.9% of 5 year-olds defining intelligence as a non-cognitive attribute, but 81.8% of 7 year-olds and 100% of 11 year-olds defining it as a cognitive ability ($\chi^2 = 32.40$, $df = 2$, $p < .001$).

Figure 5.3: Percentage of children giving cognitive responses to the question, “What does it mean to be clever?”



In response to being asked about the characteristics associated with intelligence, 78.9% of 5 year-olds mentioned characteristics specific to non-cognitive attributes, yet 69.6% of 7 year-olds and 100% of 11 year-olds cited cognitive abilities ($\chi^2 = 30.60$, $df = 2$, $p < .001$). There were no significant age trends in children’s understanding of the causes of cleverness (73.7% of 5 year-olds, 63.2% of 7 year-olds and 73.9% of 11 year-olds gave non-cognitive answers) (see Table 5.1).

The analysis then considered children’s responses to the ability vignettes (see Table 5.2). There was no significant association between response category and age for “Why do you think she is getting all of her work right?” (59.1% of 5 year-olds and 56.5% of 7 year-olds gave cognitive responses, whereas 68% of 11 year-olds gave non-cognitive responses). In response to “Will she get lots right in all of her school subjects” the majority of 5 (80%) and 7 (62.5%) year-olds agreed whereas 92% of 11 year olds disagreed ($\chi^2 = 28.14$, $df = 2$, $p < .001$). In terms of the stability of performance, 92% of 5 year-olds and 80% of 7 year-olds agreed that the character would still get lots of schoolwork right when she was older. However, 88% of 11 year olds responded “no/maybe” ($\chi^2 = 39.24$, $df = 2$, $p < .001$).

Table 5.1: Understandings of intelligence: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Definition			
Knowledge/Achievement	12	60	92
Effort	0	4	0
Thinking Ability	4	8	0
Good Citizen	40	8	0
Non-cognitive	28	4	0
General cognitive ability	8	4	4
Nurturing Environment	0	0	0
Misc	4	12	4
Don't Know	4	0	0
Total cognitive responses	26.1%	81.8%	100%
Characteristics			
Knowledge/Achievement	12	60	100
Effort	0	12	0
Thinking Ability	0	0	0
Good Citizen	40	8	0
Non-cognitive	20	8	0
General cognitive ability	4	4	0
Nurturing Environment	0	0	0
Misc	16	8	0
Don't Know	8	0	0
Total cognitive responses	21.1%	69.6%	100%
Causes			
Knowledge/Achievement	0	16	8
Effort	16	20	32
Thinking Ability	8	4	4
Good Citizen	32	24	36
Non-cognitive	8	4	0
General cognitive ability	12	8	12
Nurturing Environment	12	12	8
Misc	0	8	0
Don't Know	12	4	0
Total cognitive responses	26.3%	36.8%	26.1%

In the low ability vignette when asked, “Why do you think he is getting all of his work wrong?” there was a significant age trend in responses ($\chi^2 = 6.02$, $df = 2$, $p = .049$) with 60.9% of 5 year-olds, 64% of 7 year-olds and 90.9% of 11 year-olds giving ‘non-cognitive’ responses. In response to “Will he get lots wrong in all his school subjects?” 76% of 5 year-olds agreed. However, 60.9% of 7 and 100% of 11 year-olds responded “no/maybe” ($\chi^2 = 30.54$, $df = 2$, $p < .001$). In relation to the

stability of poor ability over time 78.3% of the 5 year-olds agreed that poor ability would be stable over time whereas 84% of 7 year-olds and 100% of 11 year olds responded “no/maybe” ($\chi^2 = 38.46$, $df = 2$, $p < .001$).

5.3.2 Effort and Intelligence

Table 5.3 illustrates a significant age trend in children’s belief that clever children work hard in school. All 5 year-olds (100%) and most 7 year-olds (96%) but only 52% of 11 year-olds responded that clever children work hard at school ($\chi^2 = 24.28$, $df = 2$, $p < .001$). However this statistic should be treated with caution because 50% of cells had an expected frequency of less than 5. With reference to whether children who are not clever work hard, a developmental trend in responses was also evident; most 5 and 7 year-olds reported that they would not (87.5% of 5 year-olds and 72% of 7 year-olds). By contrast 92% of 11 year-olds responded “yes/maybe” ($\chi^2 = 35.53$, $df = 2$, $p < .001$).

Table 5.4 shows a developmental trend in children’s responses to questions relating to the stability of intelligence. In response to “If someone is clever, will they always be clever?” 84% of 5 year-olds and 60.9% of 7 year-olds responded “yes” whereas 92% of 11 year-olds responded “no/maybe” ($\chi^2 = 30.28$, $df = 2$, $p < .001$). The question “If someone is not clever, can they change to get cleverer?” revealed no developmental trend with the majority of all age groups agreeing that change is possible (79.2% of 5 year-olds, 75% of 7 year-olds, and 92% of 11 year-olds).

Table 5.2: Ability/Performance: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Reason for good performance			
Knowledge/Achievement	4	8	4
Effort	8	20	40
Thinking Ability	40	28	24
Good Citizen	24	20	28
Non-cognitive	4	0	0
General cognitive ability	8	16	4
Nurturing Environment	0	4	0
Misc	8	4	0
Don't Know	4	0	0
Total cognitive responses	59.1%	56.5%	32%
Good performance in all subjects			
Yes	80	60	8
No	0	12	20
Maybe	20	24	72
Don't Know	0	4	0
Good performance over time			
Yes	92	80	12
No	8	4	0
Maybe	0	16	88
Don't Know	0	0	0
Reason for poor performance			
Knowledge/Achievement	0	4	0
Effort	0	28	20
Thinking Ability	36	20	8
Good Citizen	48	36	60
Non-cognitive	8	0	0
General cognitive ability	0	12	0
Misc	4	0	12
Don't Know	4	0	0
Total cognitive responses	39.1%	36.0%	9.1%
Poor performance in all subjects			
Yes	76	36	0
No	16	12	40
Maybe	8	44	60
Don't know	0	8	0
Poor performance over time			
Yes	72	16	0
No	20	36	20
Maybe	0	48	80
Don't know	8	0	0

Table 5.3: The relationship between effort and intelligence: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Intelligence suggests effort			
Yes	100	96	52
No	0	0	0
Maybe	0	4	48
Don't Know	0	0	0
Lack of intelligence suggests effort			
Yes	8	16	28
No	84	72	8
Maybe	4	12	64
Don't Know	4	0	0

Table 5.4: The malleability of intelligence: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Intelligence as stable trait			
Yes	84	56	8
No	8	16	28
Maybe	8	20	64
Don't know	0	8	0
Potential to increase intelligence			
Yes	76	72	92
No	16	16	0
Maybe	4	8	8
Don't know	0	4	0

5.3.3 Developmental Differences in Understandings of Effective Thinking

Figure 5.4 shows that, to define good thinking, 75% of 5 year-olds, 68.4% of 7 year-olds and 84% of 11 year-olds in total defined it as a cognitive ability, a finding which is not statistically significant. When asked to define the characteristics of good thinking the younger children responded in terms of both cognitive and non-cognitive characteristics (52.9% of 5 year-olds and only 43.7% of 7 year-olds defined characteristics as non-cognitive) whereas 87.5% of 11 year-olds defined good thinking as a cognitive ability ($\chi^2 = 6.30$, $df = 2$, $p = .043$). When asked about the causes of being a good thinker there were no significant age differences with all three ages citing it as being due to cognitive ability (57.9% of 5 year-olds, 60% of 7 year-olds and 73.9% of 11 year-olds) (see Table 5.5).

Figure 5.4: Percentage of children giving cognitive responses to the question, “What does it mean to be a good thinker?”

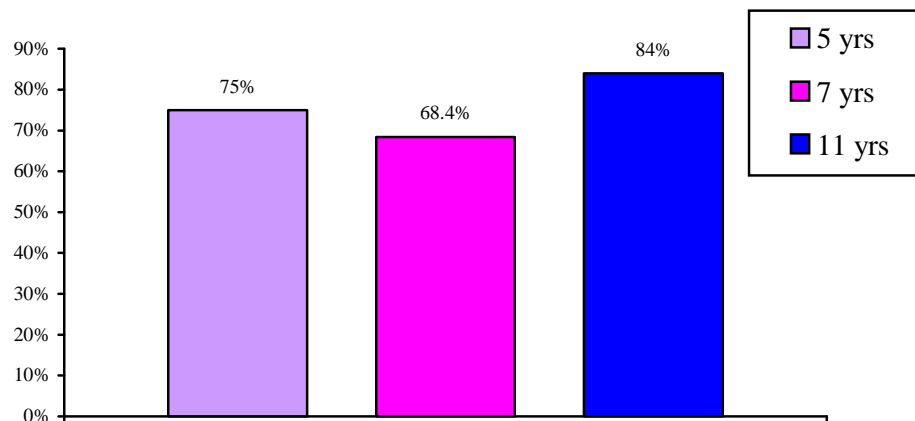


Table 5.5: Understandings of effective thinking: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Definition			
Knowledge/Achievement	12	12	12
Effort	4	4	8
Thinking Ability	48	40	72
Good Citizen	12	12	8
Non-cognitive	4	8	0
General cognitive ability	0	0	0
Nurturing Environment	0	0	0
Misc	12	4	0
Don't Know	8	20	0
Total cognitive responses	75.0%	68.4%	84.0%
Characteristics			
Knowledge/Achievement	16	24	28
Effort	0	12	0
Thinking Ability	16	12	28
Good Citizen	24	12	8
Non-cognitive	12	4	0
General cognitive ability	0	0	0
Nurturing Environment	0	0	0
Misc	20	20	32
Don't Know	12	16	4
Total cognitive responses	47.1%	56.3%	87.5%
Causes			
Knowledge/Achievement	0	16	0
Effort	8	16	8
Thinking Ability	40	20	56
Good Citizen	16	12	16
Non-cognitive	8	4	0
General cognitive ability	4	12	12
Nurturing Environment	0	4	0
Misc	4	4	8
Don't Know	20	12	0
Total cognitive responses	57.9%	60.0%	73.9%

5.3.4 Children's Understandings of Individual Thinking Skills

Creative Thinking: When questioned about the phrase 'thinking up ideas', 80% of 5 year-olds did not understand the phrase 'thinking up ideas' and defined it simply as a cognitive/non-cognitive ability. In contrast, 52% of 7 year-olds and 100% of 11 year-olds demonstrated a clear understanding of the term 'thinking up ideas' ($\chi^2 = 32.12$, $df = 2$, $p < .001$) (see Figure 5.5 and Table 5.6).

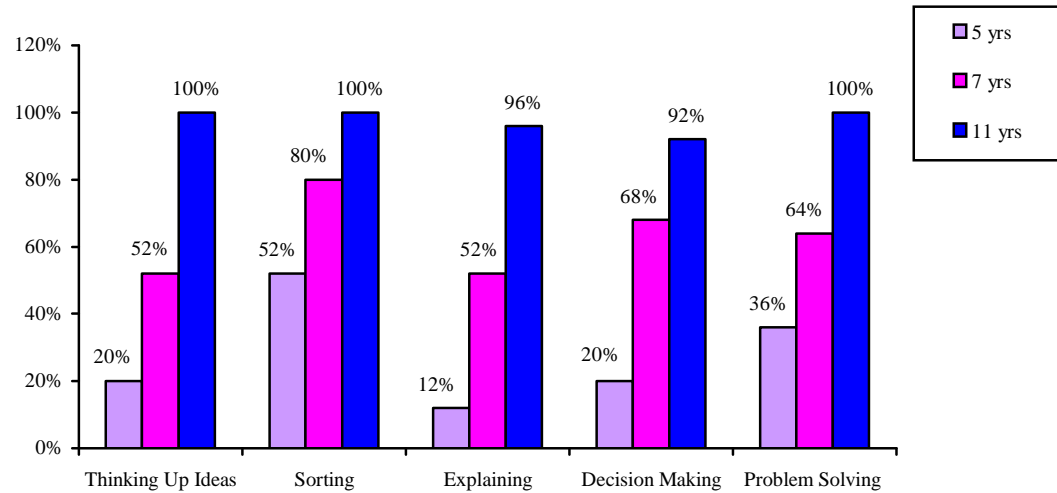
Searching for Meaning: There was an age difference in children's understanding of 'sorting' with 52% of 5 year-olds, 80% of 7 year-olds and 100% of 11 year-olds showing a clear understanding of the concept ($\chi^2 = 16.58$, $df = 2$, $p < .001$).

Critical Thinking: There were age differences in children's understanding of 'explaining' with 88% of 5 year-olds showing a lack of understanding, but 52% of 7 year-olds and 96% of 11 year-olds revealed clear understanding of 'explaining' ($\chi^2 = 35.46$, $df = 2$, $p < .001$).

Decision Making: There were also significant age trends in children's understanding of 'decision making', with 80% of 5 year-olds providing inaccurate responses. By contrast, 68% of 7 year-olds and 92% of 11 year-olds were able to explain the concept appropriately ($\chi^2 = 28.00$, $df = 2$, $p < .001$).

Problem Solving: 64% of 5 year-olds did not have a clear understanding of the term 'problem solving', compared to 64% of 7 year-olds and 100% of 11 year-olds who did. ($\chi^2 = 23.16$, $df = 2$, $p < .001$).

Figure 5.5: Developmental trends in children's understanding of thinking skills:
Percentages of children demonstrating clear understanding of skill



5.3.5 Correlations between Children's Views of Intelligence and Effective Thinking

The relationship between children's definitions of 'cleverness' and 'good thinking' was tested using the contingency coefficient. There was no significant correlation between the two variables (*contingency coefficient* = .15, $p = .231$). Similarly, when respondents' answers regarding the characteristics of 'cleverness' and 'good thinking', and causes of 'cleverness' and 'good thinking' were analysed, small positive correlations were found but these correlations were not significant (characteristics: *contingency coefficient* = .27, $p = .058$; causes: *contingency coefficient* = .26, $p = .053$).

Table 5.6: Children's understandings of individual thinking skills: Percentages of children responding in each category

	P1 (%)	P3 (%)	P7 (%)
Thinking up Ideas			
Understanding of thinking up ideas	20	52	100
General cognitive Ability	56	40	0
General non-cognitive ability	12	4	0
Good citizen	8	4	0
Don't Know	4	0	0
Sorting			
Understanding of sorting	52	80	100
General cognitive Ability	20	4	0
General non-cognitive ability	12	4	0
Good citizen	4	0	0
Don't Know	12	8	0
Misc	0	4	0
Explaining			
Understanding of explaining	12	52	96
General cognitive Ability	36	24	4
General non-cognitive ability	20	0	0
Good citizen	12	4	0
Don't Know	16	12	0
Misc	4	8	0
Decision Making			
Understanding of decision making	20	68	92
General cognitive Ability	32	16	4
General non-cognitive ability	16	4	0
Good citizen	16	8	0
Don't Know	12	4	4
Misc	4	0	0
Problem solving			
Understanding of problem solving	36	64	100
General cognitive Ability	32	20	0
General non-cognitive ability	0	0	0
Good citizen	20	4	0
Don't Know	8	12	0
Misc	4	0	0

5.4 Discussion

The purpose of this study was to examine children's views about intelligence and to extend previous research in this area by investigating children's concepts of effective thinking and individual thinking skills.

Age trends in concepts of intelligence

The results supported the predictions regarding developmental trends in concepts of intelligence. Older children focus more on cognitive abilities in their definitions of intelligence (particularly knowledge), and the characteristics of intelligence. By contrast, younger children define intelligence to a larger degree on non-cognitive abilities and social skills. This is concordant with other research (discussed in Chapter 2) showing that from a young age children tend to include more social characteristics and that these definitions become more knowledge-based with time (Heyman et al., 2003; Stipek & Tannatt, 1984). However, at all ages, children appeared to link the cause of ‘cleverness’ to being a ‘good citizen’.

In contrast to previous studies (e.g., Dweck & Elliot, 1983; Kurtz-Costes et al., 2005; Stipek & Daniels, 1988), findings from this study indicate that younger children are most likely to believe in temporal constancy of intelligence/ability; that a clever person will always be clever. However, all three age groups reported that it is possible for a person to change from being ‘not clever’ to ‘clever’, suggesting that across age there is a belief that intelligence is malleable rather than fixed. Therefore, as with previous studies in this area, conflicting data has been discovered as the findings also indicated that younger children are more likely to believe that a clever person will always be clever.

Thus young children in this study have a less cognitive view of intelligence and see intelligence as more fixed and generalisable across subject areas. By contrast older children see intelligence as cognitive, malleable and not consistent across school subject areas. This age trend may be the result of the educational system in which the children in this study participate. By the end of primary school, children in the UK have been exposed to a variety of educational assessment techniques. This reinforces the suggestion made in Chapter 1 that children may come to judge intelligence as being heavily based on cognitive processes of knowledge acquisition and memorisation (Yussen & Kane, 1985). This interpretation suggests that children’s views of intelligence and ability are at least partly a product of the culture in which they are based (Kinlaw & Kurtz-Costes, 2003; Rosenholtz. & Simpson, 1984). In

this respect, the developmental changes and lack of gender differences found in this study concur with the findings of other developmental studies (e.g., Kurtz-Costes et al., 2005; Yussen & Kane, 1985).

These findings have clear implications for the third study in this thesis. Firstly, these data suggests that, by the time children reach their final year of primary school, the majority of children believe that ‘being intelligent’ is equal to remembering facts and scoring high marks on tests. This finding was particularly shown in children’s responses to the questions about the definitions and characteristics of intelligence. However, children of the same age are much less certain about how to become more intelligent (i.e., the *causes* of cleverness), with the majority of primary seven pupils citing that adopting passive characteristics (e.g., listening to the teacher, not talking in class) would help them become more clever. For this reason, the intervention study presented over the next two chapters aimed to deepen children’s awareness of active strategies, skills and dispositions that can be employed to help them become more intelligent; that becoming more intelligent is not a passive activity. Furthermore, on a more fundamental level, practitioners involved with the intervention will be encouraged to increase children’s awareness that ‘intelligence’ is a much broader construct than simply equalling knowledge. Regarding children’s views of the malleability of intelligence, the findings are encouraging for the intervention study, as the majority of primary 7 pupils interviewed in this study believe that intelligence is not a stable trait. It is important to the success of educational interventions that learners realise that it is within their capacity to become more intelligent.

A developmental trend was also found in children’s concepts about the relation between effort and intelligence. In agreement with Kurtz-Costes et al. (2005), younger children in this study tended to associate increased effort expenditure with increased ability, and similarly, that poor ability is associated with an inherent lack of effort. This study gives more weight to the theory that from age seven there is a reversal in the way children view this relationship (Kinlaw & Kurtz-Costes, 2003). These findings also suggest that older children conceptualise a complex relationship

between effort and ability whereby ability is not automatically enhanced or reduced through effort or a lack thereof. The majority of pupils in this age range qualified their answers with comments to suggest that the causes for ability are pupil, situation and subject specific, that one rule cannot be applied to all children. The findings concerning effort and ability also have implications for Study 3; children's and teachers' awareness of the important role effort has to play in succeeding on tasks needs to be highlighted.

Age trends in concepts of thinking

Few age trends were found in children's theories about effective thinking when the responses were analysed quantitatively, perhaps reflecting that many children find it difficult to conceptualise good thinking. However, it should be noted that, when asked to define good thinking, the majority of children within the primary 7 age group responded within the category of 'thinking ability', although this finding was not statistically significant. Whilst this finding initially seems encouraging, the category of 'thinking ability' also included general responses such as the ability to think 'faster', which does not necessarily equate with thinking 'effectively'. This could possibly provide confirmation of the suggestion made in Study 1, that within learning environments where practitioners are encouraging learners to display 'good thinking', to 'think about it' and 'think harder', they are insufficiently precise about the nature of the *type* of thinking they are asking children to do, and therefore when children are asked to define 'good thinking' they find it difficult as it has never been defined for them in school. This speculation is supported by the view that it is imperative to develop children's language of thinking (which will be an aim of the intervention lessons in Study 3) so that children learn to associate thinking words with precise cognitive processes, such as 'estimate', 'conclude', 'compare & contrast' (Costa & Marzano, 2001; Tishman, Perkins, & Jay, 1995).

The present findings suggest that a valuable aim of educational interventions could be to determine whether children understand the cognitive procedures implied by the term 'thinking', and whether they know *how* to improve it. Furthermore, in this study very few respondents associated effective thinking with the use of thinking

skills outlined in psychological models of thinking skills such as creative and critical thinking skills, decision making and problem solving (e.g., Ashman & Conway, 1997; McGuinness, 2003; Swartz & Parks, 1994). Similarly, few participants mentioned good thinking as being synonymous with metacognition and self-regulated learning; aspects which educational theorists widely agree on as being some of the most fundamental aspects of effective thinking.

Although there was not a clear developmental trend regarding children's understandings of the definitions, characteristics and causes of effective thinking, there was a striking trend in children's knowledge of individual thinking skills. By the time children reach secondary school (i.e., 11/12 years of age), this study has shown that the majority of primary seven children have a clear understanding of core thinking skills, whereas younger children are not aware of what it means to think up ideas, give explanations, make careful decisions and solve problems well. However, children at all ages were shown to have an understanding of the thinking skill 'sorting'. Whilst this finding will be discussed further in the final chapter of this thesis, it also signals that intervention studies should gather more in-depth baseline data to see if children are aware of the thinking processes involved in each skill. This study focused on determining whether children knew what it meant to 'sort' and 'think up ideas', for example, it did not examine whether the primary seven children able to define the skills were then able to explain the cognitive processes they would apply to, for example, make decisions carefully and solve problems effectively.

It was predicted that there would be a strong correlation between children's understandings of cleverness and good thinking. The data gathered from this study does not support this prediction. There was no correlation found between children's views of these two concepts. This finding will also be discussed in more detail in Chapter 8 and in relation to all three studies conducted. However, the lack of a correlation between these two concepts implies that a focus for the third intervention study presented in this thesis must be to raise teachers' and children's awareness that thinking skills, strategies and dispositions are important components of intelligence.

5.4.1 Conclusions

The findings of the present study confirm marked developmental changes in children's understanding of intelligence. Furthermore, a novel contribution has been the examination of children's concepts of effective thinking that showed no developmental changes, and individual thinking skills where age trends were revealed. The results have important implications for teachers in terms of their use of thinking skills language in the classroom and their efforts to enhance children's thinking skills to improve children's cognitive ability, and are taken into consideration in the third study of this thesis. Future research should include a wider age range and an adult sample to examine how these concepts develop through adolescence and adulthood.

The first study conducted in this thesis discovered baseline data on teachers' understandings of effective thinking, their views about collaborative learning and their beliefs about how frequently they integrate thinking skills into the curriculum. However, the questionnaire-based approach did not examine how teachers were teaching the thinking skills and if they were being explicit to learners about the thinking processes to employ for each skill. This developmental study of children's concepts has highlighted the need for future interventions to deepen children's awareness of the elements involved with being 'clever' and being 'a good thinker' and to more clearly define the relationship between the two phenomena. Furthermore, whilst primary seven pupils have been shown to have a basic understanding of some common thinking skills, it is not known whether they are able to apply the skills effectively (in terms of the specific thinking processes) in relevant contexts. Based on these findings from Studies 1 and 2, Study 3 (presented over two chapters) provides a detailed analysis of the effects of intervening to challenge practitioners' and pupils' concepts of intelligence and effective thinking, to deepen awareness of the core elements involved in 'good thinking', and to develop children's thinking skills.

CHAPTER 6

STUDY 3: AN INTERVENTION AIMED TO DEVELOP CHILDREN'S THINKING SKILLS

Intervention Development and Procedure

6.1 Aims of this Chapter

The purpose of Study 3 was to unite fundamental research points from both Studies 1 and 2 by designing an intervention study which would increase teachers' and pupils' understanding of effective thinking and demonstrate strategies to enhance this ability by infusing thinking skills into the curriculum. In contrast to the previous studies, this study will be reported over two separate chapters (Chapters 6 and 7). This chapter will introduce the rationale and design for the intervention study and define the materials used to create it. The close work with teachers and the relationship established with the schools involved will also be described. Chapter 7 will present the research-oriented evaluation of the intervention. The intervention had two purposes. The first was to challenge the understandings identified in Studies 1 and 2. The second was to contribute to current debate (see Chapter 3 for a discussion) regarding effective ways of teaching and assessing thinking skills. This study was devised to gather more research on the effectiveness of infusing thinking skills into the curriculum, an approach which remains under-researched.

Findings from Study 1 suggested that teachers' concepts regarding the elements and skills associated with effective thinking need to be deepened. Furthermore, that teachers need clearer guidance on how to teach a variety of thinking skills within the curriculum, ensuring the cognitive processes associated with thinking skills are made explicit to learners. Associated with this is the need for teachers to provide opportunities for children to develop their metacognitive skills. Study 2 indicated

children are unsure about the concept of ‘good thinking’, and that the majority of learners do not view effective thinking in similar terms to intelligence. Many of the primary 7 pupils believed that cleverness is represented to a large extent by knowledge. Similarly, the primary 7 pupils surveyed believed that to become more clever, they should adopt passive characteristics such as, listening to the teacher, behaving in class and always following the teacher’s instructions. Moreover, whilst the majority of primary 7 pupils thought intelligence was malleable, they did not tend to recognise the positive relationship between effort and ability. A primary aim of this intervention study was therefore to encourage children to view intelligence as a malleable facet through their actions, and to help them perceive the link between intelligence and thinking skills.

6.1.1 Introduction

For the purposes of this intervention study, the individual thinking skills to be focused on were taken from the framework of McGuinness (2003). The thinking types focused on within her framework (i.e., metacognition, critical thinking, creative thinking, searching for meaning, along with cognitive strategies such as problem solving and decision making) were discussed in detail in Chapter 1 of this thesis. Furthermore, adopting the McGuinness framework for this intervention provided continuity with the previous studies in this thesis. Study 1 used the framework as the basis for the quantitative section of the questionnaire, and the five thinking skills focused on in Study 2 were taken from the five main thinking types cited in the McGuinness framework.

Chapter 3 made the distinction between discrete programmes designed to enhance children’s thinking skills and programmes aimed to infuse thinking skills throughout all curricular areas. Whilst a variety of approaches were analysed in Chapter 3 of this thesis, minimal research exists regarding which of these approaches is most effective. It therefore highlighted that how best to teach thinking skills remains contested. Previous studies have instead tended to focus on examining the effect of a particular thinking skills package (Adey, Robertson, & Venville, 2001; Edwards, 1991; Lipman, 1991; Shayer, 1999). This study will provide data on the

effectiveness of training teachers to adapt their teaching methods to incorporate elements of effective thinking. In this respect, this study is most similar to the ‘infusion’ approach. Chapter 3 highlighted that the infusion approach is one that is supported by many theorists (e.g., Beyer, 1997; Tishman, Perkins & Jay, 1995; McGuinness, 2000a, 200b; Swartz & Parks, 1994). However, with the exception of some studies that have evaluated the impact of integrating thinking skills within a particular curricular area, few theorists have attempted to assess the effects of teaching thinking skills explicitly across the curriculum. Furthermore, the infusion method will allow in-depth training to be provided on integrating thinking skills within the curriculum. Although Study 1 indicated teachers already believed themselves to be teaching thinking skills, it did not provide data on how explicit they were making these processes to children.

Whilst the main aim of this intervention was to enhance children’s thinking skills, the intervention lessons adopted a more comprehensive view of developing effective thinking, rather than purely teaching ‘skills’, something which supporters of the infusion approach encourage (see Chapter 3). For example, the importance of promoting relevant thinking dispositions (e.g., being persistent, thinking flexibly, adopting a questioning attitude) is recognised as being necessary to ensure learners use the skills that they acquire (Beyer, 1987; Claxton, 2002; Costa, 2000; Perkins, Jay, & Tishman, 1993). Similarly, encouraging the language of thinking (such as summarise, estimate, conclude, imply) is important so that learners associate thinking words with their relevant cognitive processes (e.g. Beyer, 1987, 1997; Costa & Marzano, 2001; Fisher, 2003; Kirkwood, 2005; McGuinness, 2003; Tishman & Perkins, 1997; Tishman, Perkins, & Jay, 1995; Wertine, 1987). The development of metacognition is widely accepted as being fundamental to the development of other cognitive skills (e.g. Beyer, 1987, 1997; Brown, 1987; Costa, 2001; Fisher, 2003; Grotzer & Perkins, 2000; Halpern, 1997; McGuinness, 2005). Lastly, to encourage independent thinkers, children should explicitly be taught to transfer the knowledge, skills, dispositions and strategies to their everyday lives (Ashman & Conway, 1997; Perkins & Salomon, 1987, 2001). These key aspects formed the basis for the intervention lessons in this study. Similarly, Chapter 3 also discussed the view held

by many theorists that thinking diagrams are an effective way of infusing thinking skills into subject content (Beyer, 1997; Clarke, 1991; Kirkwood, 2005; McCombs & Whisler, 1997; McGuinness, 2003; Perkins, Goodrich, Tishman, & Owen, 1994; Swartz & Parks, 1994). For the purposes of this intervention study, teachers were trained to infuse thinking skills into the curriculum using skill-specific thinking diagrams.

Another unresolved issue from the literature presented in the introductory chapters to this thesis was the effectiveness of collaborative learning as a means to enhance thinking skills. Although the majority of theorists and thinking skills approaches actively encourage learners to work collaboratively, to date, minimal research exists to endorse the benefits of collaborative learning when fostering thinking skills. Study 1 findings indicated that teachers believed that children may prefer to work collaboratively. However, findings were varied in regard to whether teachers believe collaborative learning actually enhances thinking skills and the extent to which teachers prefer to incorporate it into lesson structures. Evaluating the effectiveness of collaborative learning as opposed to individual learning will have practical and theoretical implications. Fundamentally, teachers need clearer guidance on whether collaborative learning should be an essential component of effective thinking lessons (i.e., whether its incorporation is integral to the teaching of thinking skills), or whether children's thinking skills can be enhanced through explicit teaching regardless of the skills being fostered through collaborative learning.

6.1.2 Design of the Intervention Study

The project followed the structure of pre-test – intervention – post-test over a total of twelve weeks. It involved six primary seven classes (11/12 years) and their teachers. Within this thesis, teachers and children have been focused on working within primary schools. Many intervention studies have been pitched at pupils of primary seven or older. For this reason, plus the findings taken from Study 2 that by primary seven the majority of pupils have a good knowledge of individual thinking skills, the age group of primary seven was chosen for the intervention. It was decided to run the actual intervention for eight weeks. This meant that the intervention itself (plus

the pre- and post-tests) could comfortably be included within one term, rather than spanning holidays. Furthermore, primary seven is typically a hectic year, with the last summer term involving many visits to secondary schools, therefore the third and longest term in the school year (i.e., January – April 2006) was chosen for the intervention.

Three condition effects were established by randomly assigning the six classes (from six different schools) to one of the following groups: two classes as a control ($n = 60$); two classes working collaboratively ($n = 58$); and two classes working individually ($n = 60$). For the collaborative learning classes, the teachers were asked to assign the children to appropriate mixed-ability groups of ideally four children per group. The groups remained fixed throughout the intervention.

During six weeks of the intervention a different thinking skill was taught to the experimental classes. Week four and week eight were revision weeks. With the exception of the revision weeks, the structure of each week followed the pattern of the researcher modelling the thinking skill to the class and teacher at the beginning of the week, and then the teacher replicating the lesson a further two times in that week (following a structured lesson plan) in different curricular areas. The aims of the intervention were to:

- Improve children's understanding of thinking skills through an 8-week intervention.
- Compare and contrast the efficacy of individual learning versus collaborative learning versus no input.
- Design an intervention that fully supports teachers and general teaching practice.

6.2 Developing the Teacher Intervention

The development of the intervention was extremely important as the aim was to fully support teachers through rigorously developed and useful lesson plans. Furthermore, to provide in-depth training to teachers on how to infuse thinking skills into the curriculum. The intention was also to create materials that could be used widely after the intervention. The materials that were devised were therefore thoroughly tried and tested and used to support the teachers.

As a result of the researcher's secondment to the local authority in which the three studies were conducted (mentioned in Chapter 4), her knowledge and training in this area plus her experience as a classroom practitioner ensured the intervention lessons could be used widely in classrooms. Furthermore, it meant that close working relationships with the schools involved were established.

To generate interest in the intervention, the researcher addressed all head teachers within the local authority and presented the findings of Studies 1 and 2 (i.e., that practitioners perceive a range of thinking skills to be taught, but that not all thinking types are given equal emphasis within all curricular areas). Furthermore, that these are possibly not taught explicitly as children have poor knowledge of individual skills until they reach primary 7. The researcher also raised head teachers' awareness of teachers' and pupils' conceptions of effective thinking, and the finding that, by primary 7, the majority of children view intelligence as being synonymous with knowledge acquisition.

Schools were invited to take part in one of five pilots being rolled out across the authority, as it was recognised that one approach would not be appropriate for all learners and all schools. Training and resources were provided by the authority. The aim of these programmes was to develop both teachers' and children's understanding of the elements involved with effective thinking. Schools were asked to choose between; Thinking Through Philosophy, (e.g., Cleghorn & Baudet, 2002), Six Thinking Hats, (De Bono, 1999), CoRT (De Bono, 1981, 1985); Creative Problem Solving in Collaborative Groups (Edinburgh Council, 2002/2003), and infusing

thinking skills into the curriculum using thinking diagrams (based on the methods advocated by Swartz & Parks, 1994, and McGuinness, 2003). External trainers provided the training on Thinking Through Philosophy and Collaborative Learning, but the researcher trained the schools involved with the infusion approach (which was evaluated and formed the basis for this intervention), and de Bono's programmes (the researcher is an official de Bono trainer for both CoRT and Six Thinking Hats).

Whilst all primary schools within the local authority ($n = 46$) were invited to participate in the thinking skills intervention, thirty-eight schools indicated an interest in one of the five options. Out of these thirty-eight schools, ten schools opted to take part in the 'infusion approach' pilot. Six schools were then chosen at random from the ten interested schools to take part in the official training and evaluation of the intervention.

A handbook was devised to support the four teachers involved specifically with the intervention (i.e., the two teachers of the individual learning classes and the two teachers of the collaborative learning classes) and to make the intervention as standardised as possible. The handbook included the schedule of the intervention, the rationale for the intervention, guidelines describing the generic lesson template used in each lesson, lesson plans for each thinking skill lesson, skill-specific thinking diagrams, intervention tests for each skill, and laminated flashcard resources to accompany each skill lesson. The most important stages involved when creating the handbook are discussed below; selecting the focus thinking skills, identifying the key thinking steps, formulating the lesson template and creating the lesson plans.

6.2.1 Selecting the Thinking Skills

As previously mentioned and to provide continuity with the first two studies presented in this thesis, the framework used for the intervention was by McGuinness (2003). The core thinking types present were; metacognitive skills; searching for meaning skills; creative thinking skills; critical thinking skills; decision making; and problem solving. As the intervention took the form of a short concentrated intervention, it was decided that one thinking skill should be chosen from each of the

aforementioned broader thinking types, rather than spending all eight weeks focusing on one type of thinking skill. Furthermore, the skills investigated in Study 2 highlighted that the majority of primary 7 pupils have a solid understanding of important skills within each type. Therefore, where possible, the skills chosen were the same skills as those used in Study 2.

The aim was to teach a new skill weekly over the course of the intervention. The order of the skills was sequenced to build on previously learned skills. For example, core searching for meaning skills (such as ‘grouping’) were learned first that could be reinforced in the creative thinking lessons. Similarly, the creative thinking skill of ‘coming up with ideas’ was taught prior to the decision making and problem solving strategy lessons, strategies which involve learners first generating ideas. Furthermore, the broader thinking category of metacognition was addressed by ensuring that every lesson fostered this ability, as it is widely accepted to be a fundamental element of every effective thinking lesson (see Chapter 1 for a discussion). Regardless of the cognitive thinking skill being applied, teachers need to encourage learners to plan the use of the skill, monitor how effectively it is being applied, and then reflect on the skill application process.

The first category addressed was ‘searching for meaning skills’, (e.g., sorting, noting similarities and differences/comparing and contrasting, sequencing, ranking, ordering). This type of thinking was covered first because these skills are vital if pupils are to interact with the subject content, clarifying suggestions and information and ensuring a deep understanding rather than superficial knowledge. The thinking skill ‘grouping’ (or ‘sorting’ as it was called in Study 2), was chosen as the majority of primary 7 pupils have a basic understanding of what it means to ‘group’ things. However, to be able to ‘group’ items successfully, pupils must first be able to compare and contrast items, noting how they are similar and different, and for this reason the decision was made to include two skills (i.e., comparing and contrasting and grouping) from the thinking category of ‘searching for meaning’ in the intervention. Comparing and contrasting was the first skill the learners were

introduced to in week one of the intervention, and in the second week of the intervention the skill taught explicitly was grouping.

The next skill chosen was a critical thinking skill (e.g., making predictions, finding reasons, coming to conclusions, determining bias, analysing evidence). In Study 2 the skill focused on was ‘giving reasons’, but the synonym ‘explaining’ was used in its place when piloting demonstrated that primary 1 pupils responded better to the term ‘explaining’. For the intervention study, the focus remained on the skill of ‘reasoning’, but the emphasis slightly changed and extended so that pupils were not only involved in ‘giving reasons’ for their answers, but were asked to ‘find reasons’ in other people’s views and subsequently come to a conclusion. The full title given to the skill learned in the third week was therefore ‘finding reasons and conclusions’.

The next category of thinking skills concentrated on was creative thinking skills (e.g., thinking up ideas, using imagination, taking multiple viewpoints). In a similar way to the previous skills discussed, the skill identified in Study 2 as being the most important when involved in creative thinking tasks was also used in this intervention, that is, ‘thinking up ideas’. This skill was re-titled ‘coming up with ideas’ (the synonym ‘generating ideas’ was used interchangeably with this term) as one of the main aims of the intervention was to move away from the overly broad term ‘think’. This particular method chosen to encourage learners to ‘come up with ideas’ also involved the children ‘grouping’ ideas, and in this respect it provided a strong link to the searching for meaning skills practised in the first two weeks of the intervention.

In the second last week of the intervention the thinking strategy of decision making was concentrated on. This was purposely chosen to build on the previous week’s skill of ‘coming up with ideas’, as effective decision making involves the learner in first thinking up possible alternatives, before reflecting on them. In a similar vein, the thinking strategy of problem solving was chosen to be the focus of the last week, as it too involved the learner in thinking up possible solution strategies before analysing any of them in detail. Problem solving was chosen to follow the strategy of

decision making, as skilful problem solving also incorporates elements of decision making.

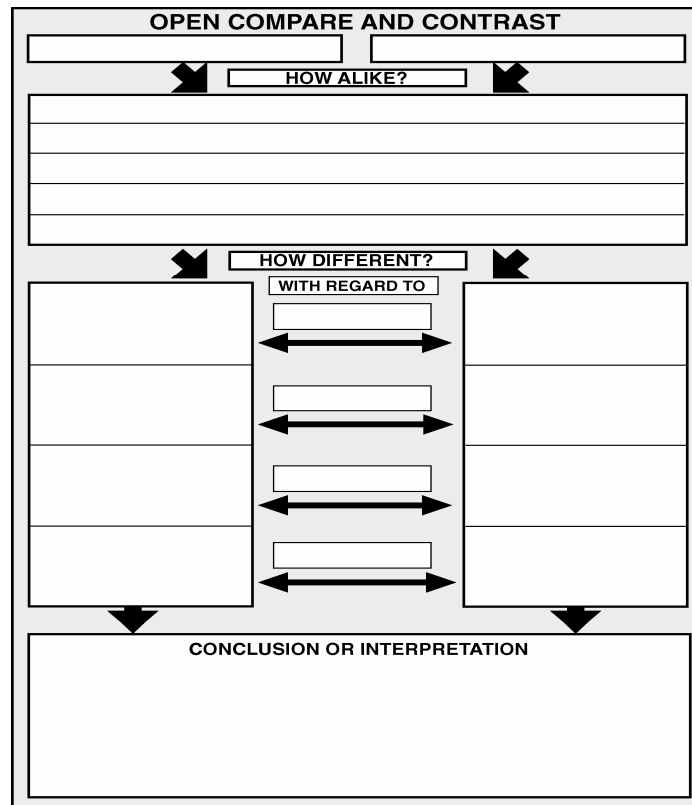
To summarise, in the first three weeks of the intervention the learners were exposed to the following skills (at a rate of one per week); comparing and contrasting, grouping and finding reasons and conclusions. At this point there was a revision week during which the pupils were reminded of each of these skills and applied them in three different subject areas. Week five of the intervention commenced focusing on coming up with ideas, followed by a week each on decision making and problem solving. The intervention finished with another revision week where each of the skills covered in weeks five, six and seven of the intervention were focused on one more time.

6.2.2 Identifying the Key Thinking Steps

Once the six skills/strategies had been selected, thought was given to the cognitive processes involved in each of the thinking skills. This meant that pupils could be taught the thinking skills in a precise way and understand the sequence and series of processes behind each of the thinking skills, as discussed in Chapter 3. Furthermore, neither Studies 1 nor 2 explored whether teachers and pupils were aware of the mental steps underpinning, for example, decision making. An important step in making the thinking skills explicit to pupils, was therefore to ensure that both teachers and pupils had knowledge of the steps involved with each skill. Thinking diagrams are an accepted way of helping learners to see the processes involved in each thinking skill (Beyer, 1987; Kirkwood, 2005; McCombs & Whisler, 1997). The key steps were therefore devised at the same time as the thinking diagrams were chosen. Initially, the thinking steps and diagrams used were based on those found in Swartz and Parks' (1994) handbook. However, where these were not found to be appropriate, the researcher designed intervention-specific formats in collaboration with Beyer (2005b).

For the skill of comparing and contrasting, the thinking diagram proposed by Swartz and Parks (1994) was used as it had been piloted effectively (see Figure 6.1).

Figure 6.1: Comparing and contrasting thinking diagram



The thinking steps devised to support the pupils when learning to compare and contrast were:

- observe the items to be compared
- identify how the items are similar
- identify how the items are different
- interpret what is suggested by the similarities and differences

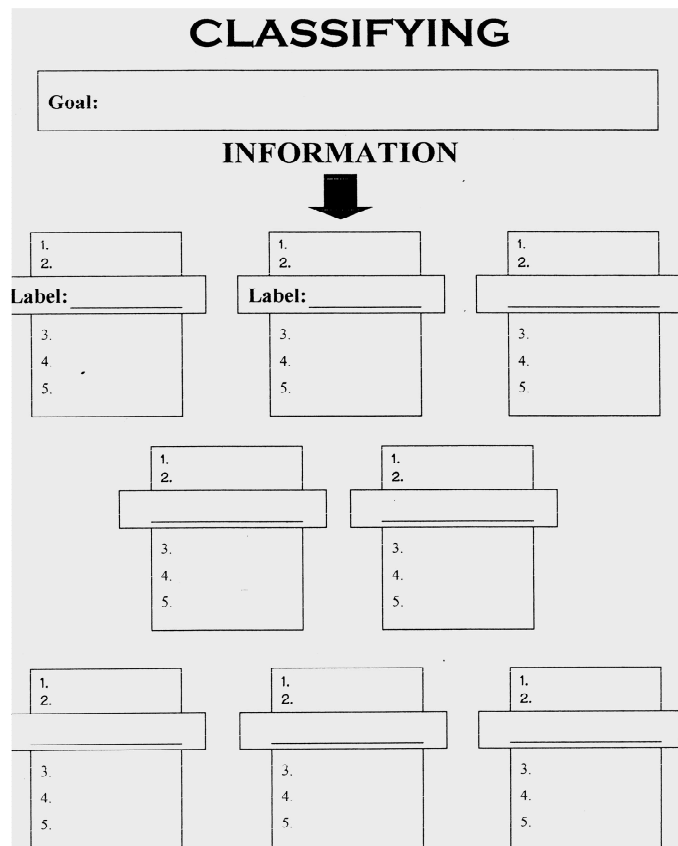
The above thinking steps were thought to be more detailed than those listed by Swartz and Parks (1994), yet still link closely to the steps pupils would perform when comparing and contrasting guided by the thinking diagram.

For the skill of grouping, Beyer's thinking diagram was used (2005a), as it was thought to more clearly reflect the sequence of key thinking steps which children

would be taught when applying the skill, particularly as his version encourages children to start to group similar items and then think of a label, rather than children having to think up the label first (see Figure 6.2). The thinking steps for this skill were:

- Scan the items to find what the pieces are like
- Select some pieces that appear to be alike
- Put these into a group
- Label the group with a word that means the feature common to all items in the group
- Add other items that fit this name/label
- Repeat this process making new groups until all items are grouped

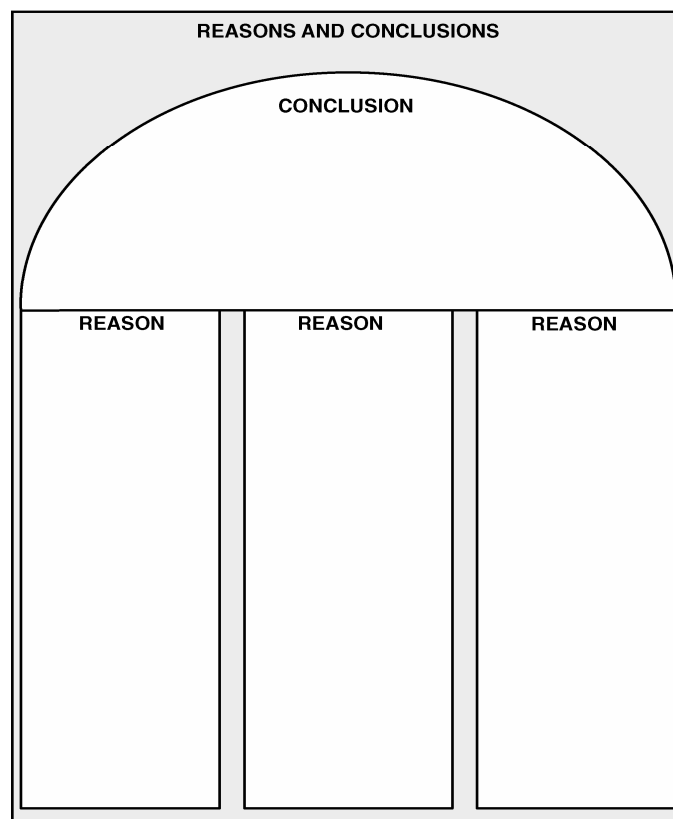
Figure 6.2: Classifying thinking diagram



For the skill of finding reasons and conclusions, Swartz and Parks' (1994) diagram was used (see Figure 6.3). However, once again, slightly more explicit skill steps were chosen rather than using the skill steps identified by Swartz and Parks, to help learners 'see' the processes involved:

- Read through (skim) the given paragraph, list, or text to
- Find a sentence (or sentences) that tells what the author is trying to convince you to accept, believe or do. This is the author's conclusion.
- Find any/every sentence or phrase that tells WHY you should accept, believe or do this. These may be reasons.

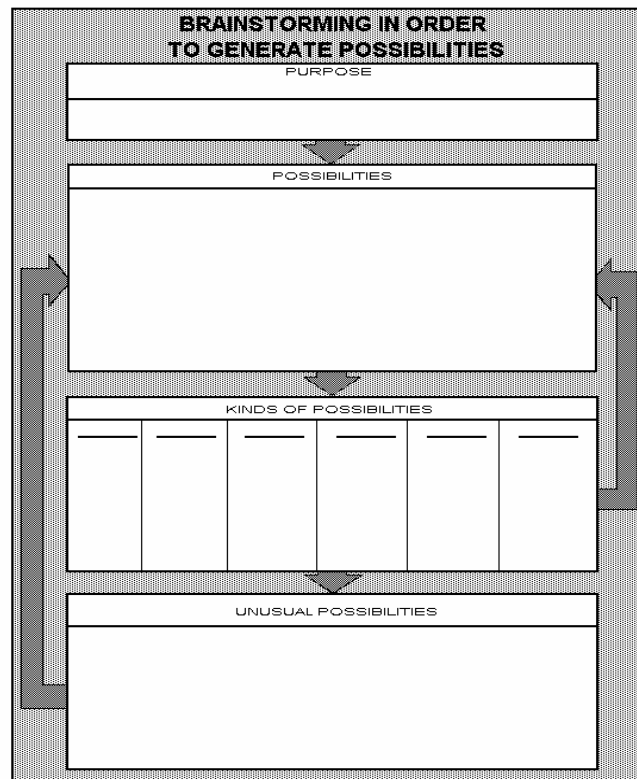
Figure 6.3: Finding reasons and conclusions thinking diagram



The thinking diagram used for ‘coming up with ideas’ was also taken from the Swartz and Parks handbook (see Figure 6.4). However, more precise thinking steps were devised to accompany their thinking diagram as it was felt that the format of the diagram needed further clarification for the learners in terms of the steps involved in performing the skill. The thinking steps for this skill were:

- state the purpose for coming up with ideas
- brainstorm many ideas
- group the suggested ideas and brainstorming new ideas for each of these groups
- add new groups and brainstorming ideas to fit each new group
- combine groups into pairs
- brainstorm ideas that blend the main feature of each group in each pair

Figure 6.4: Coming up with ideas thinking diagram



When choosing a decision making thinking diagram for the intervention, it was decided that the Swartz & Parks decision making version (1994) would not be sufficient for this intervention. As noted by Beyer (2005b), the Swartz and Parks version of a decision making thinking diagram only asks children to consider one possible option in detail. If a learner wishes to consider more than one alternative, different thinking diagrams have to be used for each option. The decision was taken therefore to devise a thinking diagram that would allow three options to be considered at one time (see Figure 6.5). Furthermore, there was also no section on the Swartz and Parks version for children to ‘choose the best option’, a crucial ultimate step involved with the skill of decision making. On a smaller note, links were made to the skill of ‘coming up with ideas’, by including terminology within this thinking diagram such as ‘brainstorming options’.

Figure 6.5: Decision making thinking diagram

I **Decision Making**
What I need to make a decision about is...

Brainstorming Options...

Options I will evaluate	Consequences	Importance	Pro / Con
1.			
2.			
3.			

My Final Choice is to...

The key steps chosen to reflect the thought processes illuminated in the thinking diagram were:

- state the goal
- brainstorm options

Then, for each option:

- predict the consequences
- consider how each consequence is important
- judge the pros and cons
- choose the “best” option

For the final skill covered, problem solving, after careful consideration the decision was taken to devise a new problem solving thinking diagram specifically for the intervention, rather than using the Swartz & Parks’ (1994) version. This decision was based on Beyer’s (2005b) observation that the main problem with the Swartz and Parks version is that their thinking diagram encourages children to view problem solving in very similar terms to decision making, using language such as ‘consequences’ and ‘pro/con’. It was felt that this meant that crucial problem solving language such as ‘solution strategies’ was missed out. Furthermore, the Swartz and Parks diagram had no section for the children to think about and list the steps involved in their plan, or evaluate how they could check that their plan has worked. For this reason the following thinking steps and thinking diagram (see Figure 6.6) were devised for the teaching of this strategy:

- state the problem
- brainstorm possible solution strategies
- select a solution strategy
- list the steps involved in the strategy/plan
- state the intended solution
- state how to check the solution and how well the plan has worked

Figure 6.6: Problem solving thinking diagram

Problem solving

My problem is...	
<p>I could solve it by...</p> <p>1.</p> <p>OR</p> <p>2.</p> <p>OR</p> <p>3.</p> <p>OR</p> <p>4.</p> <p>Strategy I will use</p>	<p>The steps involved in my plan are...</p> <p>I will check to see if my solution has worked by...</p>
Intended Solution	

The children were taught to learn the rules of the various skills by relating them to the mental processes they apply when they are carrying out the skill steps. To help them relate to this, they were encouraged to think about how they would describe how they did the skill to a younger pupil. The rules of a cognitive process are therefore made explicit to the learner, who is then encouraged to verbalise the processes that occurred inside their heads (Brown, 1987). Brown also believes that this aids transfer to other situations.

6.2.3 Formulating the Lesson Template

The basic lesson template devised for each of the intervention lessons was based on the features common to many of the thinking skills programmes, but specifically found within the 'infusion' lessons promoted by Swartz & Parks (e.g., 1994) and

McGuinness (e.g., 2003). The essence of each lesson focused on: making the thinking skill explicit by developing an appropriate and specific language of thinking, fostering relevant thinking dispositions, encouraging active thinking and skill application (using the thinking diagrams), developing metacognition and fostering transfer of the skills and dispositions to other contexts. These elements did not necessarily occur in this order, and the majority of these aspects were reinforced continually for the duration of each lesson. In addition to these, a theme permeating the intervention lessons was encouraging children to reflect on what it means to be a good thinker, the link between effective thinking and intelligence, and the belief that everyone can increase their intelligence (for example by persevering), in line with the discussions in Chapters 1 and 2.

Teaching Thinking Skills Explicitly

Children's awareness of the language of thinking was fostered throughout all intervention lessons, particularly when making the thinking skill and related thinking steps explicit. A fundamental part of each lesson was ensuring children knew the thinking skills they were learning, and how to use the thinking skill in a variety of contexts. In a similar vein, in addition to highlighting key focus words (and associated cognitive processes) during each lesson, as learners incorporated 'thinking words' into their sentences, the teachers were encouraged to pick up on these words, define them and ask the children to identify contexts where the words (and corresponding processes) could be used. In this respect, the method used was similar to that recommended by Tishman et. al. (1995) where thinking words are modelled in a meaningful context by the teacher, built up gradually and reinforced regularly in a variety of contexts.

Closely linked to the importance of developing the language of thinking, is the strategy of asking probing questions to develop children's thinking. Throughout each of the intervention lessons, the practitioners were encouraged to ask open-ended questions of the children, giving them sufficient thinking time. This echoes the rationale underpinning the Assessment is For Learning programme (e.g., Scottish Executive, 2006b) which advocates asking thoughtful questions of the children (and

encourages the learners to ask their own questions), rather than closed-ended questions based on rote-memorisation and knowledge retrieval.

Fostering Thinking Dispositions

Thinking dispositions were discussed in Chapters 1 and 3 as having an influence on each child's ability to use the thinking skills that they are taught. For the purposes of the evaluation of this intervention, the development of thinking skills was the main focus for each lesson. However, the advantages of modelling appropriate thinking dispositions were also reinforced during each lesson. Rather than covering a number of thinking dispositions in a very general way, six specific thinking dispositions were chosen to be focused on throughout the intervention. Originally, it was intended that a new thinking disposition would be introduced each week in addition to a thinking skill being focused on. However, this was decided against as it could possibly encourage learners only to associate the thinking disposition with the skill alongside it was introduced.

Various lists of thinking dispositions exist. The teachers selected to be involved in the intervention were asked to discuss various thinking dispositions prior to the intervention and come to an agreement about which ones the learners in their classes would benefit from learning the most. Teachers were given a list of Tishman, Perkins & Jay (1995) thinking dispositions, and also Costa's 13 Habits of Mind (2000). The teachers discussed each of the dispositions and came to a unanimous decision about the dispositions to be fostered throughout the intervention. The six dispositions chosen were:

- Have a go
- Have fun
- Take time to think
- Be precise
- Be persistent
- Explore new ideas

All six thinking dispositions were introduced in the first introductory lesson (for which teachers had set aside a longer amount of time in their timetables), and reinforced continuously throughout the intervention lessons.

Developing Metacognition

The lessons were also structured to support teachers with the task of developing metacognition at all stages of the lesson, particularly as Study 1 highlighted that teachers needed more support with this. A theme running throughout the intervention lessons was the importance of ‘thinking about thinking’ so that it could be improved. Teachers were directed to foster the importance of planning the thinking before it happens (e.g., choosing a thinking skill, listing the key steps involved with the thinking, devising a thinking strategy to support them with the task), to monitor the thinking as it happens and to redirect it if necessary, and to evaluate and reflect on the thinking that had taken place (e.g., identifying the skills and strategies they had employed, if they were successful, if they could have carried out the thinking in a different way, what they would change if they were to do the lesson again). To help the learners with this area of metacognition (i.e., reflecting on the thinking skill employed), at the end of every lesson, every pupil completed a ‘Thinking Diary’, which provided them with prompts to help them reflect on the thinking that had just taken place. The questions set out in the thinking diaries were:

- What skill were you learning today to help you think?
- Explain what the skill means.
- Did you enjoy the lesson? (yes/no)
- List other words that mean... (e.g., ‘classify’)
- The next time you use the skill will you do anything differently?
- Write down a sequence of the thinking steps you followed in this lesson.
- Think of one time when you might use this skill in school and one time when you might use this skill outside school.

Fostering Transfer

In addition to the last question on the thinking diaries fostering transfer (mentioned above), teachers were encouraged to promote transfer of the thinking skills, strategies and dispositions learned at all stages of the intervention lessons, not just as a single question at the end of each lesson. The intervention lessons frequently prompted teachers to ask the learners about their prior experience of using the thinking skill being concentrated on (e.g., to ask pupils to think of times when they had made ‘good’ decision in the past, or when they had made a ‘bad’ decision and what the outcome was), to think about occasions when they perhaps did not use the thinking skill but on reflection wished that they had, and to identify potential opportunities in the future to use the skill. On a more general level, practitioners were encouraged to see the importance of raising pupils’ awareness that they ought to be applying skills, abilities and knowledge learned in school in other contexts.

These core elements cited above, plus the specific strategies mentioned below, formed the generic lesson template seen in Figure 6.7.

Teaching Strategies within Lesson Content

Each lesson included a ‘warm-up’ exercise, prior to the key thinking steps being made explicit, and during which the learners were asked to apply the thinking skill. For example, at the beginning of the first creative thinking lesson – ‘coming up with ideas’, the learners’ first task was to brainstorm all of the possible uses for a large inflatable swimming prop. The progression from this warm-up activity involved asking questions such as, ‘What did you do in your heads when I asked you to ‘come up with ideas’ for this prop?’, ‘What did you do first?’, ‘Does anybody have any ideas about how we might think up more unusual ideas?’ From these questions the link was then made to the actual key thinking steps for the skill.

Figure 6.7: Generic lesson template for infusion lessons

<p style="text-align: center;">Introduction</p> <ul style="list-style-type: none"> ▪ Discussion of cleverness and good thinking (e.g., what makes someone a good thinker? Is it possible to get cleverer? If I wanted to get cleverer, what things would you advise me to do?). ▪ Make thinking skill for lesson explicit (define the skill, discuss synonyms, highlight thinking words, ask children about prior experience of using this skill in a variety of contexts). Introduce flashcards of relevant thinking words. ▪ Discuss the importance of modelling appropriate thinking dispositions when practising the skill (i.e., have a go, have fun, take time to time, be persistent, be precise and explore new ideas). Link to flashcards on display. ▪ Identify opportunities where the skill can be transferred (e.g., ask children to think of times when they may have had experience of using the skill already) ▪ Warm-Up Activity (related to the skill, children do this activity either in groups or individually depending on the condition). ▪ Identify key thinking steps for the skill (e.g., Comparing & Contrasting Key Thinking Steps – observe the items in details, notice similarities, notice differences, interpret what is suggested by significant similarities and differences). Display ‘Key Thinking Steps’ poster for the skill, and refer to general metacognitive prompts. ▪ Teacher models the thinking diagram and guides the whole class through a short example (linking to the key thinking steps poster for that skill and using the Smartboard).
<p style="text-align: center;">Development</p> <ul style="list-style-type: none"> ▪ Revise the importance of the children thinking about how good their thinking is (planning which skill to use, the steps involved, monitoring it during the task, evaluating thinking at the end). ▪ Children work on the thinking diagram in a new context (either in groups of individually depending on the intervention condition). ▪ Feedback (whole class discussion with feedback from groups/individuals, the collaborative learning condition feedback using the ‘numbered heads’ strategy).
<p style="text-align: center;">Conclusion</p> <ul style="list-style-type: none"> ▪ Revising the skill (ask children to remind you of what skill they have been learning and associated synonyms). ▪ Thinking about thinking (ask children to think about the key thinking steps they did in their heads when they were applying the skill, encourage them to evaluate how well they got on, discuss any strategies they found particularly useful and air any difficulties they may have had). ▪ Dispositions (ask children to think about and then rate [using the formative assessment technique ‘show of thumbs’] the extent to which they modelled each of the thinking dispositions). ▪ Transfer of thinking (children identify opportunities in the future where/when it would be useful for them to apply that skill). ▪ Specific focus on metacognition: Children complete ‘Thinking Diaries’ which include the following prompts: <ul style="list-style-type: none"> ▪ What skill were you learning today to help you think? ▪ Explain what the skill means. ▪ Did you enjoy the lesson? (yes/no) ▪ List other words that mean... (e.g., ‘classify’) ▪ The next time you use the skill will you do anything differently? ▪ Write down a sequence of the thinking steps you followed in this lesson. ▪ Think of one time when you might use this skill in school and one time when you might use this skill outside school.

A crucial stage of each lesson was the researcher/teacher modelling how the thinking diagram should be completed, in addition to providing the learners with the opportunity to use the thinking diagrams in the development section of each lesson (either in groups or individually depending on the control condition). This was a whole-class interactive part of the lesson and the context used for this section always had a fun emphasis designed to inspire and motivate the learners in the early part of the lesson. The thinking diagram was modelled, step-by-step, with the 'Key Thinking Steps' for the skill identified simultaneously. It should be pointed out, however, that the reason it was thought necessary for the teacher/researcher to conduct a whole-class session using the thinking diagram in each lesson was due to the fast pace of the intervention lessons, as each week a new diagram and thinking skill would be focused on. Outwith the intervention scenario, however, the first aim would be for the thinking diagrams to be infused regularly throughout a variety of subjects so that the pupils knew the processes to apply with each skill, and were able to decide how they wanted to 'think through' the processes of each skill. The thinking diagrams were only a prop to help learners structure their thoughts and to help make the 'Key Thinking Steps' more explicit. The ultimate aim, however, would be for the learners to apply the key thinking steps in a variety of situations without having to use a thinking diagram. For this reason, when the revision lessons of each skill were conducted, the children were given blank pieces of paper to help them structure their thoughts, so that the learners were not under the impression that they could only apply the thinking skills when they had the specific thinking diagram template on which they were trained.

Only after the warm-up activity (which concluded with the learners being encouraged to think about the steps they had just employed), and once the teacher/researcher had modelled an example of how to complete the thinking diagrams were the learners then asked to work on their own (or in their groups) to 'actively' apply the skill in another context.

Within each lesson there were frequent opportunities for learners to feedback their ideas to the rest of the class. For the classes working as the individual condition, the

teacher selected individuals to respond. However, for the collaborative learning condition, the teachers were encouraged to use the technique of ‘Numbered Heads’. This technique involved each group member giving themselves a number (e.g., between 1 and 5). The teacher was not aware of the numbers the pupils had given themselves, and when each group took it in turns to share their ideas, the teacher would pick a number to feedback the information. This meant that all members of each group were encouraged to contribute to the discussions and interaction as they were aware that they could be chosen to present their ideas to the rest of the class.

The children involved with the individual learning condition completed all activities within the lesson (i.e., the introduction, development and conclusion) individually, although they shared their ideas with other class members during the whole-class lesson feedback sections. By contrast, the children in the classes designated to work collaboratively did so on two occasions within each lesson – during the warm-up activity at the beginning of each lesson, and also when completing the thinking diagrams during the development section of each lesson.

Creating the Lesson Plans


Three lesson plans were created for each thinking skill (see Figure 6.8. for an example of a problem solving lesson). Each lesson always followed the structure of the template discussed above. The lesson plans began by stating the main goal for the lesson, followed by 4/5 thinking aims for the lesson. This was then followed by a statement to raise awareness of the content aim for each lesson. A list of synonyms for the skill were then given followed by the sequenced thinking steps to be focused on. Then, following the lesson template above, skill and lesson-specific questions and prompts were shown to teachers in the structure of introduction, development and conclusion.

Figure 6.8: Problem solving lesson one

Developing Young Thinkers

PROBLEM SOLVING

Lesson One

Main Goal  To guide practice in the thinking strategy, problem solving

Thinking Aims:

- To introduce the children to key steps involved when ‘problem solving’ (and related synonyms) through the use of a thinking diagram.
- To remind children of the thinking dispositions: having fun, having a go, taking time to think, being persistent, exploring new ideas, and being precise.
- To raise children’s awareness of further opportunities to transfer the strategy ‘problem solving’ to everyday life.
- To encourage children to evaluate their own thinking when ‘problem solving’.

Content Aims:

- Environmental Education – Preserving the green belt. The children will discuss the importance of the green belt and will think up solution strategies to preserve the land as it is.

Key Steps for Problem Solving

- identify the problem
- brainstorm possible solution strategies
- select a solution strategy
- list the steps involved in the plan
- state the intended solution
- state how to check if the solution has worked

Key Words:

generating options & solutions brainstorming selecting finding a solution
 steps plan solution strategies checking

Problem solving

My problem is...

<p>I could solve it by...</p> <p>1.</p> <p>OR</p> <p>2.</p> <p>OR</p> <p>3.</p> <p>OR</p> <p>4.</p> <p>Strategy I will use</p> <p>Intended Solution</p>	<p>The steps involved in my plan are...</p> <p>I will check to see if my solution has worked by...</p>
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(Problem Solving Lesson One Continued)

INTRODUCTION
<ol style="list-style-type: none"> 1) Continue whole-class discussion of what it means to be clever and a good thinker (e.g., ask the learners if they have seen any examples of good thinking lately, what it involved etc.). 2) Tell the children that in today's lesson they are going to have to think very carefully so that they solve problems. 3) Ask the children what sorts of things they might need to think about to enable them to solve problems. Highlight language of problem solving (link to flashcards for display). 4) Transfer - Ask the children to think of times when they have had to solve problems, both in and out of school. 5) Reinforce the importance of good thinking dispositions when solving problems. 6) Warm-up activity – scenario. Tell the children that they have 2 minutes to solve this problem: I need to get from the front of the class to the door, but the floor is really hot so I can't stand on it. (Children complete this either in groups or individually depending on intervention condition). 7) Children feedback suggestions (Use strategy of numbered heads for collaborative condition). 8) Ask the children what they were doing in their minds when they were trying to solve the problem – link to the key thinking steps for the strategy (display poster), and general metacognitive prompts.
MODEL THINKING DIAGRAM
<ol style="list-style-type: none"> 9) Explain to the children that to help them to think more clearly, you are going to show them how to record and organise their thoughts for problem solving – link these to the key thinking steps involved. 10) Work through an example of the diagram as a whole class using: 'You need to tie two strings together to make a washing line. But holding one in one hand you can't quite reach the other piece of string with your other hand. How can you tie the two pieces of string together?'
DEVELOPMENT
<ol style="list-style-type: none"> 1) Explain to the children that they are now going to do exactly what you just did together as a whole class, but that they are going to do it working either individually or in groups (depending on intervention condition). 2) Revise the importance of the children thinking about how good their thinking is (planning which skill to use, the steps involved, monitoring it during the task, evaluating thinking at the end). 3) Remind children to display appropriate thinking dispositions. 4) The problem you want children to solve is in the context of environmental change. Say to the children: 'Imagine that next to your home there is a large grassy area where you love to play each night. But a building company wants to build lots of apartments on that area, which will mean that you no longer have a place to play. What can you do to solve this problem?' 5) Ask children to define the problem in the section 'My problem is...' 6) Now tell the children they have roughly 5 minutes to come up with four solution strategies about what their options are. 7) Children feedback their ideas to the rest of the class. Write ideas on board. 8) Ask children to choose ONE of their ideas and to think about it in detail the steps involved in the plan. 9) Children then complete the intended solution and also list how they will know if their solution has worked or not. 10) Children feedback.

CONCLUSION	
1)	Remind children that today they have focused on solving problems– remind children of related words.
2)	Revise key steps.
3)	Ask children to self-evaluate how they got on with the thinking dispositions (use technique ‘show of thumbs’).
4)	Transfer - ask the children where else it would be useful to think things through carefully before deciding on the best way to solve a problem.
5)	Tell the children you want them to reflect on / think about how they got on in the lesson. Ask the children to fill in their ‘Thinking About Thinking’ diaries.

6.2.4 Teacher Training

Prior to the intervention, the four teachers of the experimental classes were given one twilight training session of 3 hours, and two training days on the underpinning pedagogy of effective thinking skill lessons (see Chapter 3), the identified thinking skills to be focused on, and the proposed intervention handbook.

The Twilight Training Session

In the initial twilight session the teachers were introduced to the format of the intervention. This included analysing the framework by McGuinness (2003) to discuss different types of thinking skills and how they might relate to each other, and looking in general at an ‘infusion’ lesson template. During this twilight session, the researcher modelled an ‘infusion’ lesson on the teachers using the skill of comparing and contrasting and corresponding thinking diagram.

Once the teachers understood what was involved in each lesson, the discussion then progressed to the outline of the intervention in terms of proposed timescale, the content of the lessons, thinking skills covered, curricular areas involved and the nature of the pre- and post-tests. The researcher received feedback relating to each of these aspects, and the teachers were given the opportunity to voice and discuss any anticipated difficulties. The teachers responded favourably to the suggestion of the establishment of a network, whereby, in addition to the formal training sessions received, they would have the opportunity to e-mail each other and the researcher to discuss issues and ideas as they arose throughout the intervention.

This twilight session concluded with the teachers analysing and discussing the list of thinking dispositions that could potentially be focused on during the intervention. The teachers unanimously came to a decision about the six thinking dispositions they felt the children in their classes were most in need of developing, and would complement the thinking skills covered most effectively.

During this session the teachers were also asked whether they would prefer the following 2-day training session on consecutive days, or whether they would rather have some time in between. All four teachers agreed that they would like the training sessions spaced one week apart.

The Two-Day Training Session

During the first half of the first training day, the core aspects of the lesson template (e.g., the elements involved in ‘good thinking’, what it means to be ‘clever’, making the thinking explicit, fostering thinking dispositions, developing metacognition and the importance of making the skills generalisable), were discussed in-depth. This ensured that teachers understood not only what they were to foster in each lesson, but the rationale behind doing so. The findings from Studies 1 and 2 were also presented to the teachers.

The teachers were then given their own copy of the handbook. Throughout the rest of the day the researcher modelled one lesson from the first three skills covered (i.e., comparing and contrasting, grouping and finding reasons and conclusions), focusing specifically on making the thinking processes explicit and linking the key thinking steps to the thinking diagrams. The format of the day was highly interactive yet informal, with the teachers encouraged to ask questions and request that changes be made to the lessons to make them more appropriate for their classes. Time was also given for the teachers to look carefully at all of the lessons that they would be teaching, checking that they understood the rationale behind the key thinking steps for each skill and that they had the resources necessary for each lesson.

The teachers were encouraged to read through the handbook during their time before the next training day and to think about particular areas within the effective thinking lesson template that they felt less confident about teaching.

The second full training day began with a general discussion about how they felt about teaching the lessons, if they had noticed anything about the handbook that interested them or worried them, and how much of an understanding they had of the core elements of effective thinking. For the rest of the day, the three remaining skills were analysed (i.e., coming up with ideas, decision making and problem solving), with the teachers being actively involved at all stages. Throughout these two training days, the teachers were encouraged to comment on the appropriateness of the content and level of each lesson, including how comfortable they felt with the wording of the questions. Small changes were suggested and agreed on by everyone involved, and these were incorporated into the final version of the handbook that the researcher delivered to each participating teacher in school the following week.

On-going Teacher Support

In addition to the e-mail network which was established for the intervention, as the researcher was in each school at the beginning of each week, each teacher was given the opportunity to discuss the lessons and how they were progressing. However, in addition to this, each teacher was observed teaching three thinking skills lessons throughout the intervention. These three observation lessons were spread out throughout the duration of the intervention. The first of these three observation lessons occurred for each teacher in the first week. This meant that immediate feedback could be given to the teachers and that the researcher was able to point out areas to the teacher that were not being focused on enough. During the first, fourth (revision week) and eighth (revision week) week of the intervention, each teacher was again observed following one of the lesson plans and given feedback. At the half-way point through the intervention there was another half-day training session for the teachers of the four experimental classes. During this session, the teachers were given the opportunity to feedback on the success of the lessons up until that point and to clarify queries on forthcoming lessons. The researcher also used this

opportunity to cover general points about the quality of intervention lessons observed throughout the first half of the intervention, in terms of positive aspects plus areas of weaknesses observed when following the lesson template.

The importance of the teachers' views was highlighted at all stages of the intervention process. Wherever possible, the researcher made alterations to the intervention training, procedure and the individual lesson plans in the handbook to accommodate teachers' suggestions or concerns. This enabled a strong, positive working relationship to develop between all four experimental teachers and the researcher.

Additional Teaching Materials Supplied

After the 2 training days, all of the experimental teachers were given a revised handbook. The handbook included all 24 lesson plans (3 thinking skill lessons per week for 8 weeks), blank thinking diaries and the blank thinking diagrams for each lesson. It was decided that during the section of the lesson when the researcher/teacher models the thinking diagrams, that this should be conducted using the interactive white boards, so that each pupil would clearly be able to see the thinking diagram being completed as an example. The thinking diagrams for use alongside the lessons were uploaded onto the SMART boards prior to the start of the intervention.

Each teacher was asked to set aside an area at the front of their class next to the SMART board where a display could be devised around the heading, 'What makes a good thinker?', (each teacher was given an identical laminated banner for this). All four teachers were also given a pack of display materials to put underneath the banner, including large metacognitive prompt cards (plan thinking, monitor, redirect and evaluate), and large flashcards to remind children of each of the thinking dispositions that were being focused on. Each teacher was given a large poster for each thinking skill, which displayed the key thinking steps to be performed when completing the thinking diagrams. To cultivate the language of thinking, pre-printed and laminated 'thinking words' and synonyms for each skill were organised for each

individual thinking skill. These flashcards and posters were gradually displayed throughout the course of the intervention, and in conjunction with the thinking skills being focused on. Each teacher was also given an identical large box of resources to support the lessons. This box included, for example, two large paintings to be used for the comparing and contrasting lesson two (an art lesson), a CD with two pieces of music for comparing and contrasting in lesson three plus large flashcards with the words for the ‘grouping’ lessons.

6.3 Intervention Procedure

All of the lessons used in the intervention study were first piloted on a class of primary 7 pupils ($n = 30$). This also gave the researcher the opportunity to pilot some of the pre- and post-tests that were used to evaluate the intervention on a class that had experience of the actual thinking skills lessons. These lessons were piloted from August – October, with revisions made to the handbook lessons and materials finalised from October – December.

The development work led to a standardised and supported intervention. All four classes had equivalent experiences in the intervention conditions. Whilst the intervention development was part of the education authority’s interest in developing thinking skills, the actual intervention was run like an experiment. There was very close control over all classes and similar experiences for both collaborative learning classes and individual classes. All four experimental classes (collaborative and individual learning conditions) were taught exactly the same sequence of lessons consisting of identical content; the only difference between these groups was whether children were asked to complete the tasks individually or collaboratively, depending on the intervention condition. At the end of the week in which each skill was taught, the teachers administered intervention tests, ‘ITs’. For example, at the end of the first week, the teachers administered the ‘Comparing and Contrasting IT’. The children were instructed to complete each one of these tests in silence. The format of these tests will be discussed further in the next chapter.

In addition to conducting the pre- and post-tests with each class, the researcher worked with each intervention class to model the thinking skill lesson for the week. On a Monday morning the lesson was modelled to the first of the collaborative learning classes. On Monday afternoon the researcher modelled the lesson to the first of the individual learning classes. On Tuesday morning the researcher conducted the same lesson with the remaining individual learning class, and on Tuesday afternoon the same lesson with the second collaborative learning class.

The researcher introduced the skill for the week (of which the children had no prior experience). The length of each introductory skill lesson was typically two hours. During this time the researcher was careful to follow the lesson plan so that all intervention conditions received the same input. The class teachers observed this lesson each week, following a copy of the lesson plan from the handbook and making notes where necessary. In the introduction to each of these lessons the researcher used the visual aid prompts for each skill (i.e., the thinking words for the skill, the key steps poster, the metacognitive prompt cards and the thinking disposition reminders), and gradually displayed each of the prompts on the display 'What makes a good thinker?' throughout the course of the lesson. The prompts then remained there for the teachers to use in their two follow-up lessons for the remainder of that week. The display was therefore gradually built up over the 8-week intervention.

6.4 Summary

A comprehensive intervention was designed, the creation of which evolved over a large number of months. When developing the intervention one of the central aims was that, prior to the intervention commencing and through in-depth training, all teachers involved would have an increased awareness of some of the key elements involved with effective thinking and that their concepts of effective thinking and intelligence (e.g., viewing it as malleable) would be deepened. This was an aim of the intervention as Chapter 2 discussed the impact of teachers' beliefs on their classroom practices, and the influence on children's concepts. Furthermore, the intervention training focused on teaching methodologies and was supported by a

detailed handbook. As such, by the beginning of the intervention, all teachers felt comfortable with the intervention lesson template and had a deep understanding of how to infuse the thinking skills into lesson content, making the thinking processes explicit.

In Study 1, findings indicated that teachers believed they were teaching thinking skills within the curriculum to a certain extent. Study 2 explored children's perceptions to determine whether they were aware of the skills teachers believed were being taught. Similarly, for the purposes of this study, whilst the teachers were trained to teach thinking skills explicitly to children as this chapter has shown, this was no guarantee that the children would learn the skills, or even further develop their understandings of the processes involved in the thinking skills. For this reason, a comprehensive evaluation was designed to explore the impact on children of infusing thinking skills into subject content. The evaluation built on baseline findings identified in Studies 1 and 2 and was devised to contribute to current research on the effectiveness of infusing thinking skills into the curriculum. In addition to using standardised tests, skill-specific assessments were created to address previous concerns (discussed in Chapter 3) that some evaluations of thinking skills approaches have not tested the particular skills being taught. The evaluation of the intervention, whilst concentrating on changes in children's concepts and abilities, also gathered qualitative teacher data. The results of the in-depth evaluation are presented in the next chapter.

CHAPTER 7

STUDY 3: AN INTERVENTION AIMED TO DEVELOP CHILDREN'S THINKING SKILLS³

Intervention Evaluation

7.1 Aims of this Chapter

This study aimed to unite fundamental research points highlighted in Studies 1 and 2 and to make a significant contribution to research on how to teach and evaluate thinking skills. The first two studies in this thesis investigated teachers' and children's baseline concepts of effective thinking and individual thinking skills. Study 2 also explored children's beliefs about intelligence. In contrast to the previous study, this third and final study will present the results of experimental work with teachers and children. In addition to deepening teachers' and pupils' understandings identified in Studies 1 and 2, one of the main research points for this study was to determine the effectiveness of training teachers to infuse thinking skills throughout the curriculum. Furthermore, as discussed in Chapter 6, this intervention was structured so that the effects of integrating collaborative learning opportunities into effective thinking lessons could be measured. Related to these aims was the creation of intervention-specific thinking skills assessments to monitor changes in children's ability to define, apply, metacognitively reflect on and transfer the thinking skills taught.

³ Paper (based on child data) in press in *Thinking Skills and Creativity* and has been presented at Falkirk Council's *Learning to Achieve* 2006th annual conference.

7.2 Evaluating Thinking Skills Packages

A variety of programmes were discussed in Chapter 3 designed to enhance thinking skills. Whilst many of these approaches have been evaluated in-depth, it is difficult to discern what is driving their effectiveness because the intervention studies have been typically idiosyncratic. At present there is not a standardised model and universally accepted way of measuring the effects of thinking skills interventions. For example, many evaluations conducted have utilised standardised general I.Q. tests. This method is frequently found to be problematic as the tests often do not relate specifically to the skills learned and typically do not involve the active application of those skills (Asp, 2001; Beyer, 1987; Burke, 2001; Costa & Kallick, 2001; Fisher, 2001; Kirkwood, 2005). Similarly, some studies have been shown to have methodological weaknesses, such as lack of control groups (e.g., Edwards & Baldauf, 1987; Sternberg & Bhana, 1996), or utilisation of purely qualitative data (Edwards & Baldauf, 1983). Furthermore, whilst many studies have attempted to find out children's concepts of intelligence (Droege & Stipek, 1993; Dweck & Bempechat, 1983; Kinlaw & Kurtz-Costes, 2003), comparatively few have used those findings and structured an intervention to challenge those assumptions. Similarly, little research exists on children's and teachers' concepts of what it means to be an effective thinker, and whether these can be challenged through an intervention. This study sought to tackle many of these difficulties by combining both qualitative and quantitative data through a variety of study-specific and standardised measures.

7.3 The Present Study

As indicated in Chapter 6, the present study was an eight-week intervention study with six primary seven classes (11/12 years) and their teachers. The key research questions were:

- Does teaching three thinking skill lessons per week for eight weeks increase children's thinking skills and concepts of thinking?
- Which is more effective, allowing children to work collaboratively or individually during the thinking skill lessons?

7.4 Intervention Evaluation Method

The pre- and post-tests were conducted in a standardised order, and were completed within a two week timeframe during the two weeks preceding the intervention and following the intervention. In addition to the pre- and post-tests, intervention tests were conducted throughout the duration of the evaluation. The six different school classes were randomly assigned to different intervention conditions: control, individual learning and collaborative learning. During six of the eight intervention weeks a different thinking skill was taught to the experimental classes by infusing them into the curriculum with thinking diagrams. At the beginning of each week the researcher modelled the thinking skill to each class and teacher. The teacher replicated the lesson a further two times in that week in different curricular areas following structured lesson plans.

7.5 Participants

At the beginning of the intervention 178 children and their teachers (comprising six primary seven classes) participated from six mainstream state-run schools in central Scotland. Data was collected from children and from their teachers. All parents of pupils involved in the intervention were given details regarding the nature and time-scale of the intervention. The parents/guardians gave their consent through already established home-school links. The six classes were randomly assigned to one of three groups: two classes as a control ($n = 60$; 25 boys, 35 girls); two classes working collaboratively ($n = 58$; 33 boys, 25 girls); and two classes working individually ($n = 60$; 34 boys, 26 girls). The mean age of each group of children was 11.5. Children were fully engaged and teachers were highly motivated throughout the intervention, and this meant that attrition rates were low. A small number of children (8 children in total: 3 from the control condition, two from the individual condition and 3 from the collaborative learning condition) were not present at the post-tests. There were slightly more variable rates of attrition for the weekly intervention tests. The reasons for sample attrition were due to illnesses, family holidays and local authority pupil council meetings.

Of the six teachers that took part, five were female and one was male. Both teachers of the collaborative learning condition were female. One had been teaching for 2 years and was 24 years old (“Teacher A”). The other had been teaching for 15 years (“Teacher B”) and was 40 years old. Both teachers of the individual learning condition were also female. One had been teaching for 2 years and was 35 years old (“Teacher C”), the other had been teaching for 8 years and was 30 years old (“Teacher D”). Regarding the teachers of the control condition, there was one female (aged 48 years) who had been teaching for 26 years (“Teacher E”). The other teacher of the control condition was male (aged 28 years) with 2 years of teaching experience (“Teacher F”).

7.6 Materials and Procedures

Data were gathered to detect change in pupils’ views and also the teachers’ views in a two-pronged approach. Within each of the sections below (i.e., pre-tests, intervention tests, post-tests and the Results section), the pupil measures are reported first and then attention is given to the teacher measures. Whereas the aim of providing detail on the measures used with children in the condition classes was to test the effect of the intervention on a variety of measures, the primary objective of the involvement with the teachers throughout the intervention was to support them when trialling a new methodology, supported by the handbook. The function of the majority of teacher measures (e.g., the video analysis and observations) were therefore not to judge how well they were using the handbook and integrating the key features of effective thinking into their lessons, but to discover how helpful the handbook and training were and how they might be adapted for future training sessions. The informal qualitative data gathered from the teachers was useful for the development of this work.

7.6.1 Pre-tests

Pupil Measures

Five measures were used to identify changes in children’s thinking skills and children’s perceptions of their ability. Two of the assessments were designed specifically for this study or were adapted from Study 2. The remaining three tests

were standardised. Participants were administered all five tests in a total of four sessions during the two weeks preceding and two weeks after the intervention. Participants were tested in a whole-class setting. The tasks were given to each class in exactly the same order.

Thinking Skills Assessment

Although there are some standardised tests that identify for example children's critical thinking (e.g., Ennis & Millman, 1985) or creative thinking (e.g., Torrance & Ball, 1984), few tests measure individual thinking skills within those broad thinking types and are suitable for whole class testing. De Bono (1976) notes that it is extremely important that tests to examine change in thinking ability test specifically for the skills that have been taught. As a result of this and after extensive piloting with two separate classes of primary seven pupils, a format for assessing each thinking skill (i.e., comparing and contrasting, grouping, finding reasons and conclusions, coming up with ideas, decision making and problem solving) was devised. The individual skill assessments were based on Beyer's (1987, 2001c) six-task format in which the respondent is asked to define the thinking skill, identify an example of the skill being used, apply the thinking skill on three separate occasions, and metacognitively reflect on the process of applying the skill.

Two versions of this test, version 1 and version 2, were devised (for use as either a pre- or post-test). The format, layout and structure of both versions were identical, the only difference between the versions was in the actual content/scenario of each question (see Appendix B for the full version 2 of this test). Half of the pupils from each condition were administered the 'Thinking Skills Assessment Version 1' as a pre-test, and 'Thinking Skills Assessment Version 2' as a post-test. The other half of the pupils from each condition were given Version 2 as a pre-test and Version 1 as a post-test. This test incorporated each of the six thinking skills taught throughout the intervention. For both versions, the first question asked children to define each thinking skill by matching up all six thinking skills with their respective definitions (see Figure 7.1):

Figure 7.1: Thinking skills assessment: extract from version 1

1) Match each skill on the left with what it means.

SKILL NAME	MEANING
A coming up with ideas	1 putting things together that are alike in some way
B finding reasons and conclusions	2 telling what is likely to happen next
C making decisions	3 finding how things are similar and different
D comparing and contrasting	4 putting things in the order they happened
E solving problems	5 choosing one thing from a number of possible things
F grouping	6 separating what someone wants me to believe from why he/she wants me to believe it
	7 finding a solution to a difficulty
	8 thinking of new or different things

The second question asked children to match up each skill with an example of it being used (see Figure 7.2). There then followed (for each of the six thinking skills to be focused on during the intervention) a question where the children had to apply the thinking skill (i.e. questions 3, 5, 7, 9, 11, 13), followed by a question asking children to reflect metacognitively on the thinking steps they had just used to apply the skill in the previous question (i.e. questions 4, 6, 8, 10, 12, 14). The wording was kept the same for each of the metacognitive questions. Both versions 1 and 2 of the thinking skill assessments therefore consisted of 14 questions.

Figure 7.2: Thinking skills assessment: extract from version 1

2) Match each skill on the left with the example of it being used.

SKILL NAME	EXAMPLE OF SKILL BEING USED
A grouping	1 My friend figuring out why the door won't open.
B making decisions	2 My mum trying to separate what I say is the best sweet from what makes me consider it the best.
C finding reasons and conclusions	3 My friend thinking of all the ways she could spend the £10 her gran gave her.
D coming up with ideas	4 Considering which of two jumpers I like better.
E solving problems	5 My wee cousin working out what purpose the stem has in a flower.
F comparing and contrasting	6 My brother putting dishes away in the dish cupboard.
	7 My friend selecting what subjects to take at high school.
	8 My sister placing coins in order from largest to smallest.

For each of the skill questions a skill-specific coding scheme was devised which was based on the key thinking steps of each skill, and was broken down to five main categories (see Figure 7.3 for an example of the decision making coding scheme and Appendix C for the remaining thinking skills scoring matrices)⁴.

⁴ Thanks to Professor Barry K. Beyer for advice on devising the thinking skills assessments, intervention tests and scoring matrices.

Figure 7.3: Scoring matrix for decision making skill questions

<u>Scoring Matrix</u>	
(This matrix to be used for the Thinking Skills Assessment Versions 1 & 2 no. 11; IT 5 no's. 3 – 5)	
Key Steps of Decision Making	
<ul style="list-style-type: none"> – stating what the decision is about – brainstorming options – stating possible consequences of each option – stating how each consequence is important – judging the pros and cons of each option in light of its consequences – choosing the “best” option based on the evaluation 	
Refer to ‘Key Steps’ when scoring these questions:	
Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none"> ▪ does not state or write down a final choice.
2	<ul style="list-style-type: none"> ▪ states or writes down a final choice ▪ does not demonstrate or show the application of more than 1 key step in a rational decision making process by which that choice was arrived at.
3	<ul style="list-style-type: none"> ▪ states or writes down a final choice ▪ brainstorms several possible options before making the final choice <p>BUT</p> <ul style="list-style-type: none"> ▪ lists no more than 2 consequences of selecting that option as the final choice decision. ▪ may or may not identify these consequences as pros / cons
4	<ul style="list-style-type: none"> ▪ states or writes down a final choice ▪ brainstorms more than 3 possible options before making the final choice <p>BUT for at least the option selected as the final choice:</p> <ul style="list-style-type: none"> ▪ states at least 2 possible consequences ▪ states the importance of each consequence ▪ identifies the consequences appropriately as being either a pro / con
5	<ul style="list-style-type: none"> ▪ states or writes down a final choice ▪ demonstrates at least 4 key steps involved in a DM process – including brainstorming at least 3 options, considering the consequences of each, and judging each option in terms of the pros & cons of its predicted consequences ▪ arranges these steps in a practical sequence from beginning to end.

A generic five-point coding scheme (see Figure 7.4) was also devised (with slight skill-specific alterations) to enable comparative data to be gathered on each of the metacognitive reflection skill tests.

Figure 7.4: Scoring matrix for metacognitive reflection questions

<u>Metacognitive Scoring Matrix: Skill – Decision Making</u>	
<p>Refer to Key Steps of decision making for the grid below, and for this test include:</p> <ul style="list-style-type: none"> – mention of metacognitive operations (e.g. planning ahead, monitoring work, redirecting thinking, checking and evaluating). 	
<p>Refer to Decision Making ‘Key Steps’ when scoring these questions:</p>	
Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none"> ▪ does not state or correctly describe any key steps used in applying this skill ▪ does not mention any metacognitive operation.
2	<ul style="list-style-type: none"> ▪ states and ▪ correctly describes or explains the action involved in doing 2 key steps. ▪ does not mention any metacognitive operation.
3	<ul style="list-style-type: none"> ▪ states and ▪ correctly describes or explains the actions involved in doing at least 3 key steps. ▪ does not mention any metacognitive operation.
4	<ul style="list-style-type: none"> ▪ states and ▪ correctly describes or explains the actions involved in doing at least 4 key steps. ▪ arranges these steps in a practical sequence from beginning to end. ▪ may or may not mention any metacognitive operation.
5	<ul style="list-style-type: none"> ▪ states and ▪ correctly describes or explains the actions involved in doing at least 5 key steps. ▪ arranges these in a practical sequence from beginning to end ▪ describes 1 metacognitive operation performed in applying this skill.

The coding procedure involved the researcher and an independent blind coder scoring five pre-test thinking skills assessments from each of the six classes. The inter-judge reliability score ranged between 83% to 100% for both the scoring of the skill questions and the metacognitive questions.

Identifying Concepts of Intelligence and Effective Thinking

The majority of questions in this paper were taken from the questions in Study 2 and were associated with children's understandings of the definitions, characteristics and causes of cleverness and good thinking (i.e., 'What does it mean to be clever/a good thinker?', 'How do you know if someone is clever/a good thinker?', and 'What makes someone clever/a good thinker?'). The aim was to produce data to determine whether children's conceptions of cleverness and good thinking changed as a result of the intervention. Through content analysis it soon became apparent that the same coding scheme that was used in Study 2 could also be used in this study, and therefore the following eight initial categories were established: Don't Know; Misc; Knowledge/Achievement; Effort; Thinking Ability; Good Citizen; Non-cognitive; General Cognitive; Nurturing Environment.

Figure 7.5: Categories devised to score qualitative questionnaires

Category	Example
Don't Know	
Misc.	
Knowledge	"You get all the answers right"
Effort	"You always try hard" / "He always wants to learn"
Thinking Ability	"You use your imagination" / "You can solve the problems the teacher gives you"
Good Citizen	"She does what the teacher tells her"
Non-cognitive	"He can jump high"
General Cognitive	"He has neat writing"
Nurturing Environment	"Her mum helps her a lot"

Also in a similar way to Study 2, for the purposes of statistical analyses these categories had to be collapsed. However, rather than collapsing them to reveal children responding in ‘cognitive’ or ‘non-cognitive’ terms as in Study 2, for the purposes of this study the categories were reworked to reveal any potential differences in children not responding within the category of ‘thinking ability’ (e.g., does not mention types of critical and creative thinking, problem solving, decisions making, dispositions, being motivated, using skills in other contexts), and those that correctly define cleverness and good thinking in line with experts’ definitions discussed in Chapters 1 and 2. The final collapsed categories were therefore arranged to reveal the differences between those children aware of aspects involved in effective thinking and intelligence (categories ‘Effort’ and ‘Thinking Ability’, renamed ‘Thinking Ability/Dispositions’) and those not responding within either of these two categories (all other categories, merged and renamed ‘Don’t Know’). For the intelligence questions, the final collapsed categories also retained the category of ‘Knowledge’ in addition to ‘Don’t Know’ and ‘Thinking Ability/Dispositions’.

To discover if children understand that thinking involves different cognitive processes, and to find out if their vocabulary and understanding of thinking words increased as a result of the intervention, the children were also asked, ‘There are many different ways of thinking. List all of the words to do with thinking that you know’. They then were requested to apply them appropriately in sentences to demonstrate their understanding of the terms.

The remaining question discovered children’s understandings of how skills they use in school can be used in other contexts, that is, ‘Make a list of the skills you learn in school, and then, in the column opposite, explain how you use that skill outside school’ (see Figure 7.6).

Figure 7.6: Question sequence for conceptions of intelligence and effective thinking

Pupil Questionnaire
1) What does it mean to be clever?
2) How do you know if someone is clever?
3) What makes someone clever?
4) What does it mean to be a good thinker?
5) How do you know if someone is a good thinker?
6) What makes someone a good thinker?
7) There are many different ways of thinking. List all of the words to do with thinking that you know.
8) Select five of the thinking words you wrote for number 7 and write each one in a sentence.
9) Make a list of all the skills you learn in school, and then, in the column opposite, give examples of occasions when you might use the skill at other times.
<i>N.B. For the actual questionnaire children were given a large box space for each answer.</i>

Entity/Incremental Questionnaires

Learners were given Dweck's (1999) six-question quantitative questionnaire to discover whether they held entity or incremental theories of intelligence. The respondents had to rate on a Likert-scale the extent to which they agreed with statements such as, 'You have a certain amount of intelligence, and you really can't do much to change it' (1 = strongly agree, 6 = strongly disagree), and 'You can learn new things, but you can't really change your basic intelligence'. Dweck's (1999) use of this scale has been shown to be effective in gauging conceptions of intelligence. Chapter 2 highlighted that these conceptions strongly influence a learner's motivation and confidence, and whether they display helpless or mastery oriented patterns. Identifying this in learners was seen to be important to determine if the intervention was effective in challenging these conceptions. For all six statements

(rated on a 1 – 6 scale), children responding between the numbers 1 – 3 highlighted entity views of intelligence, whereas those responding on the scale for each question between 4 – 6 suggested that they held incremental theories of intelligence.

Myself as a Learner Scale (Burden, 2000)

Whilst other tests of learners' self concepts exist (e.g., Waetjen, 1967 in Edwards & Balauf, 1987), this particular standardised test was chosen for its ability to detect children's change in attitudes towards themselves as learners, and specifically their motivation towards problem solving – both of which are key elements of this study. Furthermore, Burden (2000) suggests that a particularly useful way to employ this test as a measure would be to evaluate, “the effectiveness of an educational innovation such as a thinking skills curriculum” (p. 17). He also notes that there would be benefits when applying the MALS measure to detect changes in children's self-concepts in short-term interventions (he cites six weeks as an example).

This measure was a quantitative test in which children had to rate the extent to which they agreed with statements about themselves on a 1 – 5 scale. For scoring, the responses were coded on a basis of 1 (most negative) to 5 (most positive). The negatively worded items (as highlighted by Burden, 2000) were reversed. As there were twenty questions, this meant that each pupil could score a maximum of 100 and a minimum of 20. Burden's standardisation sample suggests that a score of 71 means a pupil has an average concept of themselves as a learner. Burden's further analyses (Principal Components Factor Analysis and an Orthogonal Varimax Rotated Factor Analysis) carried out on 389 pupils revealed correlation between ten factors; Enjoyment in problem-solving; Confidence/Academic self-efficacy; Confidence/Learning self-efficacy; Taking care with work/Careful learning style; Lack of Anxiety; Access to and use of vocabulary in problem-solving; Confidence in dealing with new work; Confidence in problem –solving ability; Verbal ability/fluency; Confidence in general ability. He carried out various tests to check for validity and reliability.

Assessment of Learner Centred Principles (McCombs, 1999)

This test is one of the few standardised assessments that measures pupils' ability to think, specifically their understanding of their own strategic, metacognitive and higher order thinking (McCombs, 1999). There is a version of this test for teachers and also a version for pupils enabling correlations to be made. This assessment differs from the MALS because the first section of this assessment asks the learner to rate the extent to which their *teacher* provides opportunities for them to become better learners.

McCombs breaks the pupils' test down into eleven sub scales, the first four of which involves the pupil having to rate the extent to which their teachers create positive relationships, honour student voice, encourage higher order thinking and adapt to individual differences. The remaining seven sub-scales ask the learner to rate themselves in terms of self-efficacy, epistemic curiosity, active learning strategies, effort avoidance strategies, task mastery goals, performance oriented goals and work avoidance goals. All eleven sub-scales are rated on an A – D scale (A = almost never, B = sometimes, C = often, D = almost always).

Teacher Measures

Two measures were used to gather data on the effect of the intervention on the teachers as a pre-test.

Identifying Concepts of Intelligence and Effective Thinking

The first of these methods was a qualitative questionnaire which was the same as the first seven questions on the pupils' version (see Figure 7.6). The rationale behind this also being incorporated as a teacher measure as well as a pupil measure was because the literature suggests (see Chapter 2) that teachers' implicit theories influence learners'. Furthermore, it is widely accepted that teachers themselves need to be able to model appropriate thinking language within the learning environment so that it is reinforced for learners in meaningful contexts.

The first six questions therefore asked teachers to define, characterise and identify causes of intelligence and good thinking respectively. Their responses were coded to these six questions using exactly the same coding scheme that were used for the children's questionnaires. The seventh question on the questionnaire asked teachers to list all of the thinking words that they used regularly in daily classroom practice. The number of thinking words listed was used to measure this.

Entity/Incremental Questionnaires

The teachers were also administered the same entity/incremental questionnaire as the pupils, again as Chapter 2 highlighted the belief which many theorists hold that teachers' views frequently affect children's (Pretzlik et al., 2003; Rosenholtz & Rosenholtz, 1981; Stipek, 1981). They therefore were asked to rate statements on a scale of 1 – 6 regarding the extent to which they believe intelligence to be malleable.

7.6.2 Intervention Tests

Pupil Measures

Intervention Tests (ITs)

A shortened version of the Thinking Skills Assessment Versions 1 and 2 was created to measure skill improvement at the end of the week in which each skill was taught. This was called the intervention test, 'IT' (see Figure 7.7 for an example of the problem solving IT). This was to compensate for the delay between the skills taught at the start of the intervention and the post-tests. The teachers of the intervention classes administered these intervention tests and were under instruction only to read the questions out to the children. The children completed these tests in silence. There were therefore six ITs in total (one for each thinking skill, see Appendix D for the full versions of the remaining five ITs). Although the ITs were more in-depth, they were devised in a similar way to the pre- and post-test Thinking Skills Assessments (i.e., versions 1 & 2) so that comparisons in the data could be made. The skill application questions and the metacognitive reflection questions were assessed using the same coding schemes and coders that were used on the Thinking Skills Assessment Versions 1 & 2.

Figure 7.7: Intervention test 6 – problem solving

IT 6

Thinking Strategy: Problem Solving

1) Circle the letter in front of whichever of the following tells what **problem solving** is:

- a. Finding a solution to a difficulty
- b. Planning things carefully
- c. Comparing two different things

2) Tell me if each of these people is **problem solving** by circling your response under each description:

a. My friend working out how to fix his model aeroplane	yes/no
b. My brother putting cutlery away in the cutlery drawer	yes/no
c. My aunt predicting tomorrow's weather	yes/no

3) You accidentally get locked into a toilet cubicle at school.
My solution would be to _____
Show your working.

4) You arrive home and realise that you have forgotten to copy your homework down from the blackboard.
My solution would be to _____
Show your working.

5) You are shopping in an unfamiliar place and have lost the adult you came with.
My solution would be to _____
Show your working.

6) List the thinking steps you did you in your head when you were solving the problem in number 5 above. Imagine you are explaining it to a primary 5 pupil.

7) List all the times you can think of when it would be useful to solve problems.

*** For the actual ITs each question was given a full page with space below for working.**

Teacher Measures

Video Data (Intervention teachers only)

A video was taken of the practitioners of the four experimental classes teaching a lesson before and after the intervention. The main reason why this method was chosen was because the success of the intervention is inextricably linked to the teachers being supported where necessary to adapt their teaching methodologies and

incorporate the underpinning pedagogy of effective thinking lessons into their teaching styles. Having a record of a typical lesson the intervention practitioners might teach was important to be able to detect if the intervention impacted on teaching styles, rather than simply training the teachers to teach the handbook lessons. The only guidance teachers were given was that the lesson videoed should be a whole-class social subjects lesson. They were also asked not to follow a prescriptive resource or lesson plan but a typical one that they might devise for their daily classroom practices. The videos were not analysed in-depth, however, as their main function was to elicit whether core elements such as thinking skills, the language of thinking, dispositions, metacognition and transfer were promoted in learning environments prior to the start of the intervention.

The researcher was not present at any of the lesson to be videoed. Furthermore, neither the pre- nor the post-test footage was analysed until after the intervention had been completed. This was to ensure that the intervention was not targeted specifically to any areas of weakness in teaching methodologies which individual teachers may have displayed.

Classroom Observations (Intervention teachers only)

In a similar vein, as mentioned in Chapter 6, the researcher observed all four of the experimental teachers teach three intervention lessons each. Informal feedback was given at the end of each lesson. The qualitative comments noted for the experimental teachers in general will be reported in the Results section.

7.6.3 Post Tests

Pupil Measures

These tests were identical to the pre-tests. They were administered in the two weeks directly following the 8-week intervention. They were given to the children in the same order and with the same timescale as the pre-tests. Many studies also put in place delayed post-testing (Adey, Shayer, & Yates, 2001; Edwards, 1991; Shayer, 1999). However, if delayed post-tests had been used in this study, teachers would not have been allowed to continue explicitly teaching thinking skills, and they would

perhaps only do so in an unofficial capacity; something which would be teacher-specific and difficult to compare between the experimental groups. Furthermore, if the teachers were instructed to ensure they did not use any of the skills and approaches they had learned throughout the training until the delayed post-test, this would be unethical. It would mean that none of the skills from the intervention could officially be built upon in their last term of primary school, a crucial time for consolidation of skills before moving on to secondary school.

Teacher Measures

During the post-test the teachers completed the same measures as in the pre-test, i.e., the qualitative questionnaires regarding concepts of intelligence and effective thinking and Dweck's Entity/Incremental quantitative questionnaire. Video footage of the intervention teachers was also gathered as a pre- and post-test.

An additional measure was incorporated into the teachers' post-tests which was a qualitative evaluation questionnaire of the intervention. Only the teachers involved with the intervention completed this test. This questionnaire included 10 questions/prompts which asked teachers to state what worked well, the areas they had difficulties with, the benefits for themselves and pupils, the negative aspects for themselves and pupils, the time-scale of the intervention, and their growth of understanding of the core elements of effective thinking. It also asked them to comment on the format of the training sessions and how useful and easy to follow they found the handbook and lesson plans. The final question asked them to write down how they intend (if at all) to build on the skills they had gained as a result of the intervention (see Figure 7.8). The qualitative comments from these questionnaires are reported in the results section.

Figure 7.8: Teacher questionnaire to evaluate the intervention

<p style="text-align: center;">Intervention Evaluation Questionnaire</p> <ol style="list-style-type: none">1) In general, how have you and your class responded to the intervention?2) Did you find the format of the training days useful? Please give reasons.3) How beneficial was it to have the thinking skill lesson modelled each week? If you did not find it helpful, can you suggest a better way to do this?4) Were there any benefits to being involved in this intervention study? If so, please detail:<ul style="list-style-type: none">- Benefits for you- Benefits for your class.5) Did you experience any difficulties with this intervention study? If so, please detail:<ul style="list-style-type: none">- Difficulties for you- Difficulties for your class.6) Has your classroom practice changed as a result of this intervention? If so, please give details.7) What recommendations / changes would you suggest if the intervention study were to be run again?8) What action, if any, do you intend to take as a result of having been involved in this pilot? <p style="text-align: center;">Any other comments?</p> <p><i>N.B. For the actual questionnaire the teachers were given a large box space for each answer.</i></p>

7.7 Results

Pupil Measures

For the following analyses a variety of statistical procedures were utilised. To detect pre- to post-test change in the standardised measures (i.e., the MALS and ALCP tests), the pupil response scales were treated as interval scales. This follows the advice of Burden (2000) and Meece, Herman and McCombs (2003) who treat the scales in a similar way. For the measures used to monitor change in the Thinking Skills Assessments and the intervention tests (ITs) devised specifically for this study, the 1 – 5 scale were analysed parametrically. Similar scales have been treated as interval scales for the purposes of parametric statistical analyses (e.g., Williams & Tolmie, 2000).

For three of these assessments (i.e., MALS, ALCP and the Thinking Skills Assessments), one-way between-groups analyses of variance were conducted to identify the impact of the intervention on the three conditions. That is, a total was obtained for each pupils' pre-test score, and a total obtained for each pupil's post-test score. Difference scores were calculated by subtracting a child's pre-test score from their post-test score. Thus each child in the study achieved a pre- to post-test difference score for each of the assessments (i.e., ALCP, MALS and the Thinking Skills Assessments). Post-hoc comparisons were then conducted to find out which conditions were significantly different from each other.

To analyse the qualitative data from the pupils' questionnaires, content analysis was used initially and the non-parametric technique of chi-square analysis employed to determine significant associations between the groups' pre-test responses, and similarly for their post-test responses. To compare the Intervention Test (IT) scores between the two experimental conditions at the same point in time, independent samples t-tests were conducted. For the following analyses, the p value was set at $p < .05$ for post hoc comparisons.

Although the following analyses will treat each condition as unitary, it is important to recognise and assess the impact of teacher's experience on the intervention. For this reason, Table 7.1 presents the mean scores for the quantitative assessments broken down by class. Whilst the mean scores will be analysed in detail later in this chapter by condition, some class-specific findings are apparent. For example, the mean scores of the MALS assessment indicates little change between the control teachers' pre- and post-test scores, and similar increases for each experimental class teacher's score. This trend was not apparent with regard to the ALCP test. Analysis of each individual teacher's scores for the ALCP shows that only one control teacher's class score remained the same (Teacher F), whereas there was an increase in Teacher E's class score. Another interesting point is that the mean score of Teacher D's class was the only one to decrease in the post-test ALCP. For the thinking skills assessments, an increase can be seen in all teachers' mean scores. However, although out of the experimental classes Teacher D's class increased to a lesser degree, all four experimental teacher's class scores highlighted much more substantial increases than the control teacher's scores. Therefore, in general, although there was some variability within the experimental teachers' classes, the differences found between each teacher's scores were small and not systematic between conditions. It is evident, however, that, as is the case with many interventions, although all teachers and children received the same input from the researcher, practitioners' personalities, dedication, teaching styles and relationships with pupils are all factors which can impinge on the intervention process. Whilst this is recognised, this was not evaluated during this intervention.

Table 7.1: Mean Scores of Quantitative Pre- and Post-Tests

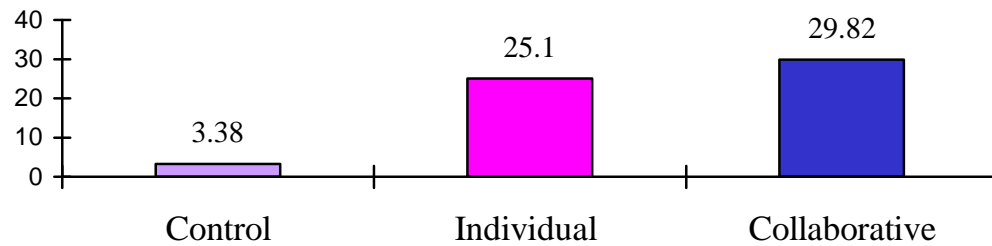
	Overall Mean Score of Thinking Skills Assessments (Figure in brackets denotes the mean score of thinking skills questions)		Overall Mean Score of MALS		Overall Mean Score of ALCP	
	Pre	Post	Pre	Post	Pre	Post
Control Class (Teacher F)	20.90 (1.17)	26.43 (1.41)	69.21	69.86	177.31	177.24
Control Class (Teacher E)	20.84 (1.21)	22.41 (1.26)	72.53	72.29	184.37	198.85
Collaborative Class (Teacher A)	22.69 (1.34)	51.38 (3.07)	70.07	74.63	184.37	186.84
Collaborative Class 2 (Teacher B)	23.82 (1.29)	54.69 (3.31)	74.14	79.58	196.46	196.95
Individual Class (Teacher C)	22.00 (1.17)	55.43 (3.26)	70.45	75.90	190.67	193.59
Individual Class (Teacher D)	24.35 (1.32)	41.69 (2.40)	72.83	78.93	203.80	195.43

7.7.1 Thinking Skills Assessments

A one-way between-groups analysis of variance was conducted to explore the impact of intervention condition on children's thinking ability as measured by individual thinking skills tests. Total scores were obtained for children's performance on the thinking skills assessment pre-test (i.e., all 14 questions). Total post-test scores were also calculated (again on all 14 questions). The following analyses were conducted on the difference score worked out by subtracting each child's pre-test score from the post-test score.

Results showed a statistically significant difference in condition between total pre-test to post-test change scores in thinking skills ($F(2, 170) = 97.11, p < .001$) (see Figure 7.9). Post-hoc comparisons using the Tamhane T2 test indicated that the mean score for the control condition ($M = 3.38, SD = 4.56$) was significantly lower than the collaborative learning ($M = 29.82, SD = 12.28$) and the individual learning ($M = 25.10, SD = 13.87$) conditions. The latter two conditions did not differ significantly from each other.

Figure 7.9: Pre-to post-test change in thinking skills ability



Individual Thinking Skills Questions

This total score was broken down to analyse the extent of the difference between pre- and post-test questions for individual thinking skills (i.e., excluding the metacognitive reflection questions). A total score was obtained for the pre- and post-tests respectively (i.e., the skills application questions, 3, 5, 7, 9, 11, 13 summed for each test) and a one-way analysis of variance conducted which showed a statistically significant difference in the mean scores ($F(2, 170) = 85.16, p < .001$), between the control condition ($M = 1.17, SD = 2.66$) and the collaborative learning condition ($M = 12.55, SD = 5.43$), and between the control and the individual learning condition ($M = 10.64, SD = 6.38$). The experimental conditions did not differ significantly from each other.

Each of the individual thinking skills was then analysed using a one-way between-groups analysis of variance. Results showed (see Table 7.2) statistically significant differences in the mean scores for all six thinking skills. Post-hoc comparisons highlighted that for four of these thinking skills (i.e., comparing & contrasting, grouping, decision making and problem solving), the mean score for the control condition was significantly lower than that of the collaborative learning condition's mean and that of the individual learning condition's. The collaborative learning condition and individual learning condition were not significantly different from each other on any of the aforementioned thinking skills.

Table 7.2: Mean performance of all three conditions on the Thinking Skills Assessment

Thinking Skill	F Value	Condition	Mean (SD)
Comparing & contrasting	[F(2, 171) = 52.66, p<.001]	Control: Collaborative Individual	.17 (.79) 2.05 (1.23) 1.86 (1.24)
Grouping	[F(2, 170) = 7.99, p<.001]	Control Collaborative Individual	.53 (1.79) 1.64 (1.43) 1.55 (1.73)
Finding Reasons & Conclusions	[F(2, 170) = 111.01, p<.001]	Control Collaborative Individual	.05 (.53) 3.07 (1.22) 2.24 (1.46)
Coming up with ideas	[F(2, 170) = 6.69, p=.002]	Control Collaborative Individual	.45 (.83) 1.20 (1.13) .79 (1.30)
Decision Making	[F(2, 170) = 62.12, p<.001]	Control Collaborative Individual	-.02 (.43) 2.58 (1.46) 1.98 (1.72)
Problem Solving	[F(2, 170) = 46.77, p<.001].	Control Collaborative Individual	-.02 (.57) 2.02 (1.71) 2.21 (1.62)

For ‘Finding Reasons & Conclusions’, post-hoc comparisons showed significant differences between all conditions. However, for the skill ‘coming up with ideas’, post-hoc comparisons indicated that the only statistically significant difference in mean scores was between the control condition and the collaborative learning condition.

Metacognitive Reflection Questions

Total pre- and post-test scores were computed respectively for metacognitive ability by summing the metacognitive reflection questions 4, 6, 8, 10, 12 and 14 on each test (i.e., excluding the individual skill application questions). There was a statistically significant difference between pre- and post-test scores ($F(2, 170) = 83.16, p < .001$). Post-hoc comparisons showed the mean score for the control condition ($M = .72, SD = 1.52$) was significantly lower than collaborative learning condition ($M = 13.69, SD = 6.76$) and the individual learning condition ($M = 11.55, SD = 7.46$). The

collaborative and individual learning conditions did not differ significantly from each other.

When these total scores were broken down by metacognitive reflection on the individual skills, findings for all thinking skills (excluding Finding Reasons & Conclusions) showed statistically significant differences in the mean scores of the three intervention conditions (see Table 7.3). Post hoc comparisons revealed significant differences between control and collaborative learning conditions, and control and individual learning conditions. No significant differences were found between individual learning and collaborative learning conditions.

Table 7.3: Mean performance of all three conditions on the metacognitive reflection questions

Thinking Skill	F Value	Condition	Mean (SD)
Comparing & contrasting	[F(2, 170) = 66.76, p<.001]	Control: Collaborative Individual	.15 (.90) 2.31 (1.29) 2.28 (1.27)
Grouping	[F(2, 170) = 50.13, p<.001]	Control Collaborative Individual	.30 (.65) 2.13 (1.32) 2.21 (1.41)
Finding Reasons & Conclusions	[F(2, 170) = 82.88, p<.001]	Control Collaborative Individual	.03 (.52) 2.65 (1.22) 1.98 (1.48)
Coming up with ideas	[F(2, 170) = 36.67, p<.001]	Control Collaborative Individual	.17 (.38) 1.98 (1.49) 1.47 (1.38)
Decision Making	[F(2, 170) = 49.16, p<.001]	Control Collaborative Individual	.03 (.26) 2.27 (1.46) 1.72 (1.65)
Problem Solving	[F(2, 170) = 51.85, p<.001]	Control Collaborative Individual	.03 (.32) 2.35 (1.48) 1.90 (1.69)

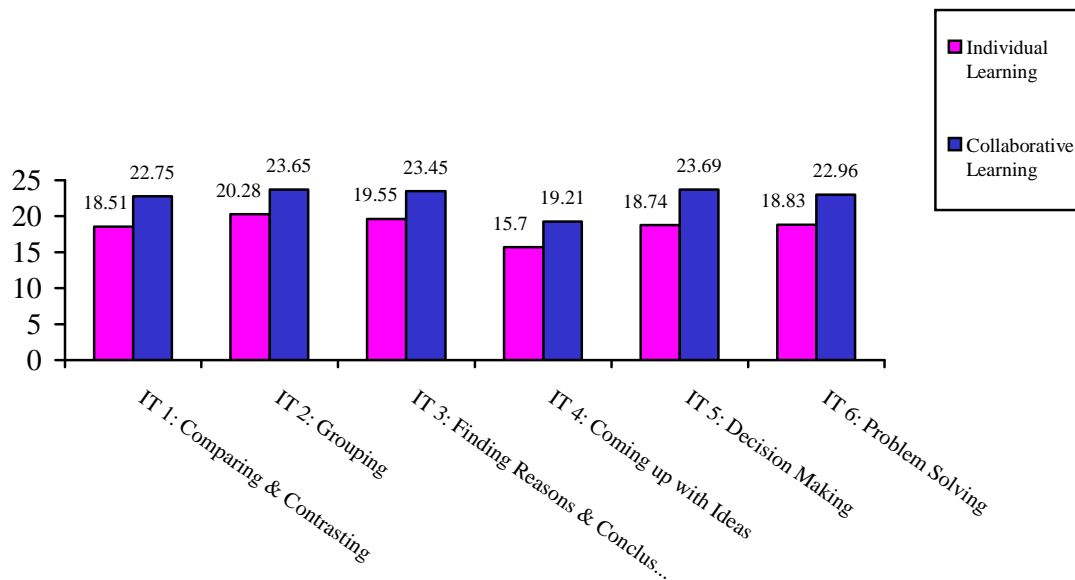
There were significant differences between each of the intervention conditions for 'Finding Reasons & Conclusions'.

7.7.2 Intervention Tests (ITs)

Independent-samples t-tests were used to compare the IT mean scores for the collaborative and individual learning conditions. There was a significant difference in the total score (across six ITs) between the collaborative condition ($M = 144.17$, $SD = 18.38$), and the individual learning condition ($M = 110.77$, $SD = 28.98$), ($t(64.934) = 6.007$, $p < .001$).

When each of the six ITs was analysed separately the mean score of the collaborative learning condition was statistically significantly higher than that of the individual learning condition (see Figure 7.10).

Figure 7.10: Mean performance of intervention conditions on the Intervention Tests



Closer analyses of the questions within each IT were then conducted (see Table 7.4). For the multiple choice questions (questions 1 and 2) where the learners were asked to define the thinking skill being used, the only significant difference was for the comparing and contrasting IT where the collaborative learning condition scored significantly higher than the individual learning condition. When the scores were analysed individually for each of the other questions (i.e., the thinking skill application questions 3 – 5), the metacognitive reflection question on each individual

IT (question 6) and the last question on each IT (question 7) regarding learners' ability to identify opportunities to transfer the thinking skill), for each IT the collaborative learning condition's mean score was significantly higher than the individual learning condition's mean score. The only exception was within the metacognitive question where for IT3 (Finding Reasons & Conclusions) no significant differences were found.

7.7.3 Correlations between Thinking Skills Assessments and ITs

The relationship between the total thinking skills ability during the pre- and post-tests (as measured by versions 1 & 2 of the Thinking Skills Assessments) and the total thinking skills ability during the intervention (as measured by the IT tests) was investigated using Pearson product-moment correlation coefficient. In general, there was a strong, positive correlation between the two variables ($r = .75$, $n = 75$, $p < .001$), with high performance on the pre and post-test thinking skills assessments associated with high performance during the intervention on the weekly ITs.

To analyse this relationship further with regard to the specific ITs, the same measure was performed between the Thinking Skills Assessment total (versions 1 & 2 which made up the pre and post-tests) and each of the six individual ITs. For each of the ITs, data revealed strong positive correlations between the two variables (see Table 7.5).

Table 7.4: Breakdown of the mean performance of the intervention conditions on the individual questions within the ITs

Thinking Skill	t Value	Condition	Mean (SD)
Comparing & Contrasting			
Total Difference	t(110)= 4.57, p<.001	Collaborative Individual	22.75 (5.09) 18.51 (4.73)
Skill Definition (Questions 1 & 2)	t(108.89) = -2.78, p<.006	Collaborative Individual	3.69 (.54) 3.39 (.62)
Skill Application (Questions 3 – 5)	t(110) = -3.34, p<.001	Collaborative Individual	11.60 (2.75) 9.88 (2.71)
Metacognitive Reflection (Question 6)	t(105.73) = 2.44, p=.016	Collaborative Individual	3.85 (.99) 3.33 (1.26)
Skill Transfer (Question 7)	t(110) = 3.68, p<.001	Collaborative Individual	3.60 (2.54) 1.91 (2.31)
Grouping			
Total Difference	t(106.89) = 3.23, p=.002	Collaborative Individual	23.65 (5.11) 20.28 (5.79)
Skill Definition (Questions 1 & 2)	N.S.	Collaborative Individual	3.75 (.76) 3.77 (.71)
Skill Application (Questions 3 – 5)	t(107) = -2.20, p=.030	Collaborative Individual	12.17 (2.74) 10.95 (3.04)
Metacognitive Reflection (Question 6)	t(104.53) = 2.12, p=.036	Collaborative Individual	3.75 (1.01) 3.28 (1.29)
Skill Transfer (Question 7)	t(107) = 4.12, p<.001	Collaborative Individual	3.98 (2.22) 2.28 (2.09)
Finding Reasons & Conclusions			
Total Difference	t(108.79) = 3.59, p<.001	Collaborative Individual	23.45 (5.34) 19.55 (6.12)
Skill Definition (Questions 1 & 2)	NS	Collaborative Individual	3.58 (.89) 3.36 (.91)
Skill Application (Questions 3 – 5)	t(101.13) = -3.06, p=.003	Collaborative Individual	13.45 (3.08) 11.22 (4.51)
Metacognitive Reflection (Question 6)	NS	Collaborative Individual	3.70 (1.19) 3.28 (1.36)
Skill Transfer (Question 7)	t(109) = 3.13, p=.002	Collaborative Individual	2.72 (1.98) 1.69 (1.47)

Coming up with Ideas			
Total Difference	$t(102) = 3.25, p=.002$	Collaborative Individual	19.21 (5.79) 15.70 (5.22)
Skill Definition (Questions 1 & 2)	NS	Collaborative Individual	3.54 (.97) 3.61 (.65)
Skill Application (Questions 3 – 5)	$t(91.94) = -2.26, p=.026$	Collaborative Individual	9.02 (3.44) 7.66 (2.66)
Metacognitive Reflection (Question 6)	$t(104) = 2.11, p=.038$	Collaborative Individual	3.46 (1.50) 2.82 (1.61)
Skill Transfer (Question 7)	$t(103) = 4.08, p<.001$	Collaborative Individual	3.06 (1.99) 1.61 (1.66)
Decision Making			
Total Difference	$t(106.94) = 4.85, p<.001$	Collaborative Individual	23.69 (4.72) 18.74 (6.02)
Skill Definition (Questions 1 & 2)	NS	Collaborative Individual	3.57 (.60) 3.43 (.78)
Skill Application (Questions 3 – 5)	$t(105.50) = -2.40, p=.019$	Collaborative Individual	12.59 (3.01) 11.00 (4.00)
Metacognitive Reflection (Question 6)	$t(90.22) = 4.79, p<.001$	Collaborative Individual	4.06 (.90) 2.88 (1.62)
Skill Transfer (Question 7)	$t(100.74) = 5.16, p<.001$	Collaborative Individual	3.46 (2.30) 1.43 (1.82)
Problem Solving			
Total Difference	$t(104) = 3.57, p<.001$	Collaborative Individual	22.96 (5.59) 18.83 (6.32)
Skill Definition (Questions 1 & 2)	NS	Collaborative Individual	3.68 (.85) 3.72 (.66)
Skill Application (Questions 3 – 5)	$t(104) = -2.47, p=.015$	Collaborative Individual	12.00 (3.78) 10.08 (4.22)
Metacognitive Reflection (Question 6)	$t(92.83) = 3.50, p<.001$	Collaborative Individual	4.42 (1.01) 3.57 (1.45)
Skill Transfer (Question 7)	$t(87.12) = 4.66, p<.001$	Collaborative Individual	2.87 (1.85) 1.47 (1.15)

Table 7.5: Correlations between pre- post-test thinking skills assessments and weekly ITs

Thinking Skill	Pearson product-moment correlation coefficient
Comparing & Contrasting	R=.60, n = 106, p<.001
Grouping	R=.60, n = 104, p<.001
Finding Reasons & Conclusions	R=.61, n = 105, p<.001
Coming up with ideas	R=.71, n = 101, p<.001
Decision Making	R=.61, n = 106, p<.001
Problem Solving	R=.71, n = 102, p<.001

7.7.4 Concepts of Intelligence and Effective Thinking

Questions relating to children's understandings of intelligence and effective thinking were analysed using non-parametric statistics. In order to conform to a statistical analysis of chi-square, the categories were collapsed, and recoded data sets are reported here.

Analysis of the pre-test responses to 'What does it mean to be clever?', found no significant association between the groups, with 73.8% of the control group, 69.4% of the individual group and 77.6% of the collaborative learning group defining cleverness as 'Knowledge'. However, the responses to the same question for the post-test indicated a significant association between the groups as 71.7% of the control responded in the 'Knowledge' category, but 76.7% of the individual learning group's answers and 85.7% of the collaborative learning group's answers fell within the 'Thinking Skills/Dispositions' category ($\chi^2 = 82.35$, $df = 4$, $p < .001$).

Analysis of the pre-test responses to the second question, 'How do you know if someone is clever?', did not show a statistically significant association between the groups, with the majority of children again responding in the 'Knowledge' category (control 78.7%; individual 77.4%; collaborative 74.1%). In contrast, there was a

significant association between groups' post-test responses, as, although the control group still responded within the category of 'Knowledge' (84.7%), the majority of children within the experimental conditions answered within the 'Thinking Skills/Dispositions' category (individual 61.7%; collaborative 78.6%) ($\chi^2 = 67.2$, $df = 4$, $p < .001$).

A similar pattern was evident for the third question relating to cleverness – 'What makes someone clever?' For the pre-test scores there was no significant association between the groups, with both the control (42.6%) and the individual learning condition (38.7%) responding in the 'Don't Know' category, and the majority of collaborative learning children responding within the category of 'Knowledge' (39.7%). However, analysis of the post-test scores indicated a significant association between the three groups ($\chi^2 = 44.44$, $df = 4$, $p < .001$). A similar number within the control condition responded 'Don't Know' (38.3%) as responded 'Thinking Skills/Dispositions' (38.3%), and both the individual learning condition (80%) and collaborative learning condition (89.3%) responded within the 'Thinking Skills/Dispositions' category.

For the fourth question, 'What does it mean to be a good thinker?', the pre-test responses did not indicate a significant association between the groups, with 45.9% of the control group responding in the 'Thinking Skills/Dispositions' category, and both the experimental conditions responding 'Don't Know' (individual 51.6%, collaborative 53.4%). In contrast, when the post-test scores were analysed, a significant difference was apparent between the three intervention conditions ($\chi^2 = 42.28$, $df = 4$, $p < .001$); whereas the majority of the control group responded within the category of 'Don't Know' (46.7%), both the individual learning group (61.7%) and the collaborative learning group (75.0%) responded within the category of 'Thinking Skills/Dispositions' to define 'good thinking'.

When asked about the characteristics of a good thinker, the pre-test responses were not significantly different, and all groups responded 'Don't Know' (control 37.7%; individual 38.7%; collaborative 55.2%). Analysis of the post-test answers revealed a

statistically significant trend, with 36.7% of the control condition responding within the 'Don't Know' category, but 66.7% of the individual learning condition and 75% of the collaborative learning condition answering that 'Thinking Skills/Dispositions' make someone a good thinker ($\chi^2 = 34.97$, $df = 4$, $p < .001$).

The last question of this type asked children to identify the causes of becoming a good thinker, but, unlike the other responses to previous pre-test questions, there was a slightly significant difference between the three groups; all groups responded within the 'Don't Know' category (control 42.6%, individual 56.5%, collaborative 69%) ($\chi^2 = 9.71$, $df = 4$, $p = .046$). When the post-test responses were analysed there was also a significant trend between the groups, but, whereas the majority of the control group still responded within the 'Don't Know' category (48.3%), most of the children within the individual learning (80.0%) and collaborative learning (76.8%) conditions now believed that 'Thinking Skills/Dispositions' were responsible for becoming a good thinker ($\chi^2 = 33.39$, $df = 4$, $p < .001$).

For questions seven and eight on this test (i.e., Number of thinking words known, and the extent to which those words are understood), one-way between-groups analyses of variance were conducted to measure the impact of the intervention on the three intervention conditions. In terms of the number of thinking words known by the children, there was a statistically significant difference in the mean scores of all three groups ($F(2, 173) = 109.16$, $p < .001$). Post-hoc comparisons revealed that the mean score for the control group ($M = .05$, $SD = .79$) was significantly lower from both the individual learning condition ($M = 9.85$, $SD = 5.69$) and the collaborative learning condition ($M = 16.46$, $SD = 8.89$). Furthermore, these latter two conditions were significantly different from each other. For the second part of this question which checked children's understanding of the thinking words, the analysis indicated that there was a significant difference between mean scores here also ($F(2, 173) = 84.94$, $p < .001$). Post-hoc tests indicated that there was a significant difference between the control group ($M = .02$, $SD = .87$) and the individual learning group ($M = 2.03$, $SD = 1.40$), and also the collaborative learning group ($M = 2.52$, $SD = .953$).

The individual learning condition and the collaborative learning condition were not significantly different from each other.

For the last question on the questionnaire, relating to children's ability to recognise opportunities to transfer the skills they acquire in school to other areas, the analysis of the mean scores indicated a significant difference ($F(2, 173) = .000, p < .001$). Post-hoc comparisons were conducted to determine where the main difference lay and it was found that the control group mean score ($M = -.07, SD = .55$) differed significantly from both the individual condition ($M = 2.18, SD = 1.94$) and the collaborative learning condition ($M = 4.39, SD = 1.91$). The individual learning condition's mean score also differed significantly from the collaborative learning group's mean score.

7.7.5 Entity/Incremental Questionnaires

A one-way between-groups (control, individual, collaborative) analysis of variance was conducted on the difference between the pre- and post-test total entity/incremental scores. There was a statistically significant difference found between the mean score of the three intervention conditions ($F(2, 168) = 6.57, p = .002$). Post-hoc comparisons using the Scheffe test indicated that there were significant differences between the control ($M = .17, SD = 3.91$) and the collaborative learning condition ($M = 2.74, SD = 3.54$), and between the collaborative learning condition and the individual learning condition ($M = .60, SD = 4.48$). The control condition and the individual learning condition did not differ significantly from each other.

7.7.6 Myself As a Learner Scale (MALS)

A one-way between-groups (control, individual, collaborative) analysis of variance was conducted on the difference between the pre- and post-test total MALS scores. There was a statistically significant difference in the pre- to post-test total MALS scores for the three conditions ($F(2, 163) = 5.43, p = .006$). Post-hoc comparisons using the Tamhane 2 test indicated that the only significant difference was between

the control ($M = .25$, $SD = 6.5$) and the collaborative learning condition ($M = 4.49$, $SD = 1.34$).

Analysis of variance then compared group differences in the pre-test and post-test scores of the individual ten factors comprising MALS. 'Enjoyment in problem-solving' showed that there was a significant difference between the three groups ($F(2, 165) = 3.94$, $p = .023$), with post-hoc tests highlighting that the collaborative learning condition's mean score ($M = 1.67$, $SD = 3.87$) was significantly different from the control's ($M = -.07$, $SD = 2.93$). The individual learning condition did not differ significantly from either of the other two groups ($M = 1.16$, $SD = 4.48$).

For 'Confidence about learning ability/Learning self-efficacy' there was a significant difference between the intervention conditions ($F(2, 166) = 4.04$, $p = .019$). Post-hoc tests showed that the main difference was between the control classes ($M = -.07$, $SD = 2.47$) and the collaborative learning classes ($M = 1.53$, $SD = 3.69$), with the mean score for the individual learning condition not differing significantly from either the control or the collaborative learning conditions ($M = 1.34$, $SD = 3.66$).

There was a statistically significant difference for 'Taking care with work/Careful learning style' across the intervention conditions ($F(2, 166) = 3.78$, $p = .026$). Post-hoc comparisons highlighted a significant difference between the control ($M = -.18$, $SD = 1.27$) and the individual learning conditions ($M = .59$, $SD = 1.91$). The collaborative learning condition ($M = .32$, $SD = 1.63$) did not differ significantly from either of the other conditions.

'Access to and use of vocabulary in problem-solving' showed a significant difference between the intervention conditions ($F(2, 166) = 3.32$, $p = .038$). Post-hoc tests did not allow this significant effect to be attributed to any specific condition or combination of conditions. In contrast, analysis of 'Verbal ability/fluency' highlighted a significant difference between the scores of the three groups ($F(2, 166) = 4.06$, $p = .020$). Post-hoc comparisons indicated that the mean score for the control classes ($M = -.08$, $SD = .962$) was significantly different from the individual learning

classes ($M = .48$, $SD = 1.16$). The collaborative learning condition did not differ significantly from either of the other two conditions ($M = .09$, $SD = 1.13$).

There were no group differences in 'Confidence about schoolwork/Academic self-efficacy', 'Lack of Anxiety', 'Confidence in dealing with new work', 'Confidence in Problem Solving Ability' and 'Confidence in general ability'.

7.7.7 Assessment of Learner Centred Principles (ALCP)

As with the above measure, to analyse this test a one-way between-groups analysis of variance was conducted to explore the impact of the intervention on children's perceived learner-centred principles. When the total difference between the post-test and pre-test mean scores for the three intervention conditions was compared, results indicated a borderline statistically significant difference ($F(2, 146) = 3.03$, $p = .05$).

The scales were broken down into eleven sub scales as directed by McCombs. According to McCombs, the subscales within the ALCP have good internal consistency (e.g., Meece, Herman, & McCombs, 2003). Alpha reliability coefficients using the pre-test marks from the total student sample were calculated on all eleven scales and are reported in the text below.

Positive Relationships (alpha coefficient: .82): A one-way analysis of variance was conducted to determine the extent to which the learners perceived their teachers to create positive interpersonal relationships and climate. There was a statistically significant difference between the three intervention conditions ($F(2, 167) = 4.1$, $p = .018$). Post-hoc comparisons using the Scheffe test showed the mean score for the control condition ($M = 2.46$, $SD = 3.72$) was significantly higher than the individual condition ($M = .17$, $SD = 4.36$). The collaborative condition ($M = 1.34$, $SD = 4.87$) did not differ significantly from either of the other two conditions.

Higher Order Thinking (alpha coefficient: .71): The mean scores for children's perception of their teachers encouraging higher order thinking and self-regulation were analysed and a significant difference found between the groups ($F(2, 169) =$

7.0, $p = .001$). Post-hoc comparisons indicated that the control condition's mean score ($M = 1.82$, $SD = 3.67$) was higher than the individual learning ($M = -.98$, $SD = 4.14$), and collaborative learning ($M = .54$, $SD = 4.39$) conditions' mean scores.

No significant differences were found for: student voice (*alpha coefficient*: .71); children's belief about the extent to which their teachers adapt to individual developmental differences (*alpha coefficient*: .68); self-efficacy (*alpha coefficient*: .68); epistemic curiosity (*alpha coefficient*: .56); active learning strategies (*alpha coefficient*: .82); effort avoidance strategies (*alpha coefficient*: .74); task mastery goals (*alpha coefficient*: .74); performance oriented goals (*alpha coefficient*: .67); work avoidance goals (*alpha coefficient*: .58) (see Table 7.6).

Table 7.6: ALCP factors showing no significant differences in mean scores

Factor of ALCP	ANOVA
Student Voice	$F(2, 167) = 2.8, p = .064$
Individual Differences	$F(2, 168) = 2.32, p = .102$
Self-Efficacy:	$F(2, 164) = .86, p = .426$
Epistemic Curiosity	$F(2, 164) = 2.3, p = .105$
Active Learning Strategies:	$F(2, 164) = 1.8, p = .170$
Effort Avoidance Strategies	$F(2, 160) = 1.2, p = .316$
Task Mastery Goals:	$F(2, 168) = 2.4, p = .096$
Performance Oriented Goals	$F(2, 167) = 1.4, p = .262$
Work Avoidance Goals	$F(2, 164) = .37, p = .689$

Teacher Measures

As there were fewer individuals involved, statistical analysis of the teacher data was not possible. However, depth of understanding was sought through informal qualitative approaches.

7.7.8 Concepts of Intelligence and Effective Thinking

In terms of their definitions of cleverness, in the pre-test five out of six teachers responded in the category of 'knowledge'. The other teacher (assigned to the collaborative learning group) reported 'thinking ability'. Analysis of the post-test data revealed that, whilst the two control teachers still reported 'knowledge', all four of the experimental teachers responded in the category of 'thinking ability'.

Prior to the intervention when teachers were asked if they could cite the characteristics of cleverness, all six teachers responded in the category of 'knowledge'. After the intervention, whilst the control teachers still cited 'knowledge', all four of the experimental teachers responded in the category of 'thinking ability'.

For the third question to do with the causes of cleverness, there was more variation in the respondents' pre-test answers. Three of the experimental teachers still cited 'knowledge' but the fourth experimental teacher and both of the control teachers responded in the category of 'nurturing environment'. The post-test data showed that whilst the control teachers still responded in the category of 'nurturing environment', all four experimental teachers cited 'thinking ability'.

When asked to define good thinking, all six teachers responded within the category of 'thinking ability' for both the pre- and the post-tests. When the teachers were asked about the characteristics associated with good thinking, five of the teachers reported 'thinking ability' but one of the control teachers responded in the category of 'knowledge'. Analysis of the post-test answers to the same question highlighted that the same five teachers still reported 'thinking ability', but the control teacher that had responded 'knowledge' now responded 'don't know'.

For the second last question on this questionnaire the teachers were asked to state the causes of good thinking and there was slightly more variation in their answers. On the completed pre-test questionnaires both of the individual teachers and one of the control teachers reported 'thinking ability'. The other control teacher reported

‘effort’. One of the collaborative learning teachers reported ‘good citizen’ and the final collaborative learning teacher reported ‘nurturing environment’. When the same question was posed to teachers in the post-test the three teachers that had reported ‘thinking ability’ in the pre-tests still responded in this way. However, both of the collaborative learning teachers had changed their views and now also reported ‘thinking ability’. The remaining teacher (in the control group) now no longer responded in the category of ‘effort’ but reported ‘don’t know’.

Regarding the number of thinking words that the control teachers knew in the post-test as compared to the pre-test, there was no difference in the number of thinking words known. In contrast, the two teachers of the individual learning conditions were able to cite 37 more thinking words in the post-test. Similarly, the teachers of the collaborative learning condition were able to cite 46 more thinking words in the post-test.

7.7.9 Entity/Incremental Questionnaires

The total responses were summed for all six questions (questions 4, 5 and 6 were negatively worded so the response scale was reversed for these items). The total score possible was 36, with a score of below 18 suggesting the teacher held entity views of intelligence, and above 18 indicating incremental views.

The first teacher’s pre-test responses (from the control condition) indicated an incremental view of intelligence (total score 26 out of 36). However, analysis of her post-test responses suggested that she had changed her views and now firmly believed intelligence was not malleable (total score 13 out of 36).

There was no change in the second control teachers’ responses from the pre- to post-test, with his responses indicating an entity view of intelligence both times (total score 17 out of 36 on both the pre- and the post-test).

There was a slight increase in Intervention Teacher A’s (from the collaborative learning condition) responses from the pre- (total score 22 out of 36) to the post-test

(total score 24 out of 36), but on both occasions she was shown to hold an incremental theory of intelligence.

Intervention teacher B's pre-test responses (from the collaborative learning condition) indicated an incremental view of intelligence (total score 22 out of 36), however this view was strengthened as the post-test responses showed a substantial increase (total score 36 out of 36).

Intervention teacher C (from the individual learning condition) on both the pre- and the post-test appeared to hold incremental views of intelligence. However, this belief appeared to have been strengthened by the post-test (total pre-test score 21 out of 36, total post-test score 30 out of 36).

Similarly, intervention teacher D's (involved with the individual learning condition) responses highlighted incremental theories before and after the intervention. The extent to which she believed in intelligence being malleable was shown to have increased in the post-test responses however (total pre-test score 24 out of 36, total post-test score 30 out of 36).

7.7.10 Classroom Observations

The researcher's global impressions of the lessons taught will be discussed below, without reference to individual teachers.

From the outset, the quality of lessons observed was excellent. Although in the first lessons observed all four experimental teachers were closely following the prompts in the lesson plan provided, by the end of the intervention the teachers were aware of the types of questions they could ask to stimulate thinking and none of the intervention teachers were still reliant on the script in the lesson plan (although they were still required to use it as a guide to ensure that all classes had equivalent experiences). Teachers of both conditions were encouraging in their manner and took time to discuss the language of thinking and model appropriate thinking dispositions at all stages of the lesson.

The teachers all referred to the flashcard prompts on their displays and made effective use of the interactive whiteboard to model the thinking diagrams.

Whilst all teachers took time to discuss the importance of planning, monitoring and evaluating thinking, this tended to be initially at set stages of the lesson (e.g., in the introduction and conclusion). After the first lesson, feedback was given to all teachers to remind them of the importance of fostering metacognition throughout the lesson, both in the formal context (e.g., during the exposition and conclusion of each lesson), but also taking more informal opportunities, such as when learners were working on the thinking diagrams, to ask children to explain their thinking processes.

After the first week it became clear that the hour set aside for each of the follow-up lessons was not long enough, as there was often not time for an in-depth feedback and summary to the lesson. The lessons from week two onwards were therefore extended to roughly one and a half hours (although the researcher still used the full allocated two hour slot at the start of each week to introduce the skill for the week).

Once the lesson time had been extended, the lessons observed from the first week onwards incorporated a more substantial discussion for the majority of teachers. However, one of the teachers of the individual learning condition needed further prompting to focus more on the skills learned in the concluding phase of each lesson, metacognitive reflection and transfer of the skill to other areas, as she was tending to place too much emphasis on the content learned.

It became evident at half way through the intervention that this same teacher was struggling (teacher C) to keep the learners in her class motivated. She was finding it difficult to keep the children enthusiastic as they did not respond well to completing the thinking diagrams in silence. Her morale was addressed through the email network established, and she was supported and encouraged by the researcher and the teacher of the other individual learning condition. She was encouraged to realise

that she was half-way through the intervention and she had seen vast improvements in them in a variety of levels.

7.7.11 Video Footage

Teacher A – Pre-intervention footage:

The context for this lesson was World War II, The Battle of Britain. The exposition of this lesson was based entirely on how much knowledge the children already had on the subject. The majority of questions were closed-ended with learners given very little time to think and reflect on what was being asked of them, e.g., “When did the battle take place?”, “Did it take place on the land, the sea or in the air?”. Frequently the teacher prompted the children into responding a certain way and dismissing answers that she did not think were correct. The children were not asked to give reasons for their answers or justify their opinions. She had pre-prepared laminated facts about The Battle of Britain which she displayed on the blackboard when the children gave her the facts she was looking for. The task learners were given was to copy down the laminated facts from the board onto a piece of paper. She was careful to tell them that she was looking for neat work and correct spelling. There was no summary to this lesson.

Teacher A (Involved with the collaborative learning condition) – Post-intervention footage:

The context of this lesson was Japan, specifically comparing and contrasting the weather in Japan with the weather in Scotland. The teacher began by explaining to the children that they would be continuing their topic on Japan, looking at the weather. She then progressed to explaining to the children that she wanted them to look at the weather in Japan and also look at the weather in Scotland. She then reminded the class that they had been learning lots of different ways to help them think recently, and she asked if anybody in the class knew of a particular thinking skill or strategy that would help them look at the weather in Japan and the weather in Scotland. Many of the children suggested using the skill of ‘comparing and contrasting’, but some of the class also suggested that it might be useful first to brainstorm key features about the weather in each of the countries first. The teacher

praised the ideas, discussing the benefits of each and asked for advice on which to use. The class then came to the decision that they would use both thinking skills; first of all to brainstorm everything they know about the weather in general, and then progressing to compare and contrast Japanese weather with Scottish weather in detail.

The teacher asked the children what it was important to remember to do when carrying out thinking skills, and the children all cited a variety of thinking dispositions (e.g., have fun, have a go, be precise) and why it was important to model each of these when thinking. Once the teacher asked the class to remind each other of the rules when brainstorming (e.g., think up as many ideas as possible, as quickly as possible, without judging or criticising ideas), the children worked in groups to brainstorm everything they could think of regarding the weather. After they had fed-back their answers (which the teacher collated on the board), they were then asked to compare and contrast the weather in the two countries. To help the children with this the teacher had prepared a fact-sheet on each of the countries. The learners were encouraged to read the information carefully, and use their prior knowledge of the weather in the countries to compare and contrast them. The teacher asked children to remind her of the thinking steps involved in comparing and contrasting, to help them organise their thought processes. She then gave each group a blank piece of paper on which the compare and contrast was to be conducted. She reminded them of the compare and contrast thinking diagram which they had used previously, but encouraged them to make up their own structure if they would rather. At this point she reminded them again that she would be looking to see them modelling thinking steps appropriate for conducting a compare and contrast, and that they should all be having a go (explaining why), having fun, being precise, being persistent, exploring new ideas and taking time to think. After each thinking step, the children were encouraged to feedback their answers to the rest of the class.

They concluded the lesson by sharing their conclusions about weather in Japan and in Scotland. The teacher also asked children to reflect on their thinking throughout the course of the lesson, how well they had worked on each thinking step, how they

worked as a team and the extent to which they modelled the thinking dispositions. The lesson concluded with the teacher asking the learners to identify occasions where it would be useful to compare and contrast items in real life.

Teacher B – Pre-intervention footage:

The context for this lesson was Planets and Space. The teacher began with an exposition of knowledge-based questions, such as, “How does man travel to space?”, “How do we know what happens in space?”. The questions progressed to more open-ended ones such as, “Are there any differences between earth and the planets that we’ve studied?” The teacher used imprecise prompts such as, “Think about it...” The first task the learners were given was a group task where the group had to sequence a list of words in order to show the most essential items for survival in space. Learners were unsure of the task however, as the teacher did not make clear what she was looking for. The teacher moved round the groups, encouraging them and questioning them. She spent a substantial amount of time asking the groups to feedback their order of words, asking them to give reasons for their answers. Children appeared motivated at all stages and on-task in groups. The next task involved the children, in groups, having to “consider” the challenges they would be faced with if they journeyed to space in terms of distance, conditions in space, human challenges and spacecraft challenges. The summary to the lesson drew on individual groups’ responses.

Teacher B (Involved with the collaborative learning condition) – Post-intervention footage:

The context for this lesson was one in a sequence of lessons on the Rainforest. The lesson began with the teacher explaining to the class that they would be working on another topic lesson, but also using a thinking skill to help them look at a particular area in detail. She then made the thinking skill explicit – comparing and contrasting. She asked for synonyms, a definition of the skill and also prompted the children to think of a time when they had previously used the skill of comparing and contrasting. She then encouraged them to remember exactly *how* they had used the thinking skill, i.e., what were the thinking steps they followed in their heads when they were

comparing and contrasting. In addition to using thinking skills, the teacher encouraged the pupils to think about what else they needed to consider before they could say they were 'good thinkers'. The children then listed and expanded upon the thinking dispositions that were focused on during the project (i.e., have fun, have a go, be precise, be persistent, take time to think and explore new ideas). They also discussed the importance of first planning the thinking before it happens, monitoring and redirecting it during the thinking, and evaluating after it has taken place.

The children were then given a warm-up exercise in groups, where they were given two minutes to study pictures of two rainforest animals and think only of the similarities. These were fed-back to the whole class before the children were given a similar amount of time to identify the differences between the two animals and then feed these back to the class. During this time the teacher supported the groups whilst she prompted them with comments such as, "Have a go, Brian, you won't be able to think up any similarities if you don't try", and "I think that as a group you perhaps need to go into more detail when discussing the similarities. Remember to be precise with your thinking and really look at the objects in a detailed way". The short section concluded with the teacher asking the children to summarise the similarities and differences between the two animals, and then to list the thinking steps they had just conducted in their groups (i.e., observe both objects in detail, identify similarities, identify differences, state what is suggested by the similarities and differences noted).

For the main body of the lesson the teacher gave each group a laminated fact-file which summarised what they had been learning so far about the rainforest people and village they had been finding out about. Each group was then asked to compare and contrast life in the rainforest with life in their town in Scotland. Each group was given a blank sheet of paper to conduct this compare and contrast and encouraged to display the information however they wished, but that they had to be able to summarise the similarities and differences that they noticed at the end of the lesson. She reminded them again of the thinking steps that they should be conducting in their

heads. The teacher supported the groups and directed them to consider various points during this discussion.

During the plenary, each group fed-back their thinking about the similarities, differences and their summary using the strategy ‘numbered heads’. At this stage the teacher asked them to think about what they had learned in terms of the content of the lesson, but also asked them to think about the skill of comparing and contrasting. For this she focused on the thinking steps and thinking dispositions and metacognition, asking the children to draw on examples and state why it’s important for example, to be precise when they’re thinking, to think about the similarities and differences before coming to a conclusion about what they had noticed about the content through the process of comparing and contrasting. The children were then asked to consider a time in the future when they would be able to use the skill of comparing and contrasting, to evaluate how well they performed the skill during the lesson, and consequently whether they would change anything about how they conducted themselves during the lesson for the next time.

Teacher C – Pre-intervention footage:

The lesson context was volcanoes and earthquakes. The introduction to the lesson began with quick-fire questions about the subject, including names of countries, capital cities and countries where major earthquakes had occurred. The teacher very precisely led the children into the answers she expected, often giving extremely structured prompts such as, “No, that’s not it, the answer I’m looking for starts with the letter “B””. Textbooks were given out with great speed and the teacher very quickly read through one of the pages. The children’s first task was to complete a cloze-procedure worksheet (individually), completing sentences by inserting a word from a bank of words. The teacher read out the correct answers to the worksheets. The teacher then directed them to the next page of the textbook. Again, she read through the page quickly and then the children were asked to complete another cloze-procedure worksheet on the new topic. The lesson concluded with the teacher reading out the answers so that they could check if they had inserted the correct words in the correct places.

Teacher C (Involved with the individual learning condition): Post-intervention footage

The lesson context was preparing for the school Olympic games, discussing hurdles and the high jump. The teacher began by telling the children that they had been doing some ‘good thinking’ recently and asked the children to explain what she might mean by ‘good thinking’. One child responded, “You practise good thinking so that you can get more clever”. The teacher then asked if being clever and being a good thinker were the same thing, and another pupil responded, “They are kind of the same thing because you can’t get more clever if you don’t know when to use thinking skills and if you don’t have a go in the first place and think about how to do something before you start”.

The teacher then introduced the thinking skill to be focused on for the lesson, which was comparing and contrasting. She asked the key question, “What does it mean to compare and contrast?”, and children were able to respond by listing in detail the thinking steps that they would employ in their heads when asked to do this. To promote transfer of this skill, she asked the children if they could identify opportunities in their everyday lives when it might be useful to know how to compare and contrast two things. Thinking words and synonyms associated with the skill were asked for.

As a warm-up activity the whole class (individually) were asked to think about how a clock and a stop-watch were similar and different. The teacher modelled one way to display the information which they fed-back using the compare and contrast thinking diagram on the Smart Board.

For the main section of the lesson the children were told that as primary 7 pupils organising the mini-Olympic sports day, they would have to compare and contrast two different sports the school could take part in, so that in a later lesson they could make an informed decision about which sports they wanted to include. They were told that for this lesson they would be thinking in detail about the hurdles and the high jump. The teacher first of all checked that they knew what was involved in each

of these sports, and revised the equipment and processes involved in each. Each child was then given a compare and contrast thinking diagram that had been used in the project and asked to work on this task individually. The teacher asked the class to work in silence to do this task, and during it did not prompt any individuals to remind them about modelling appropriate dispositions, or to think about their thinking.

During the plenary to the lesson the teacher asked children what thinking steps they had gone through in their heads to compare and contrast the two sports, and how they would explain to one of their peers how to do the skill. Pupils were then asked to feedback their thinking on the thinking diagrams. The children were asked to reflect on the thinking they had done throughout the lesson, and were also asked again to think about when they could use the thinking skill of comparing and contrasting in other situations.

Teacher D: Pre-intervention footage

The lesson context was World War II – The Evacuation. As with previous teachers, this teacher began by asking a series of knowledge-based questions regarding how much the children knew about the evacuation. Questions progressed to probe more in-depth, asking questions such as, “Do you think the evacuation was a good idea? Explain your thinking”. The first task involved children working in groups and imagining that they were living in Edinburgh during the second World War. They were asked to discuss alternatives and come to a consensus about where they would want to be evacuated to and how they would get there. The teacher joined in the group discussions at this point. The groups all then fed-back their answers, being prompted to justify choices where necessary. The final task involved the children working individually to design posters that would encourage parents to send their children to the countryside to be kept safer. The summary of the lesson was a whole-class discussion which asked the learners to state what they remember from the lesson. This was based on cloze-procedure type leading questions.

Teacher D (Involved with the individual learning condition): Post-Intervention Footage

The teacher began by explaining to the class that during the afternoon they would be finding out some more about Japan. She asked the children to point out Japan on a map and state which continent it belongs to. The children were then asked to make a prediction about how many people might live in Japan. At this stage she encouraged everyone to “have a go”. She gave each individual a worksheet which included information on the population of Japan. She asked children to read out the different sections, asking children to clarify the meaning of some words and sentences to ensure all learners understood the information. The information made it obvious that there is not an even spread of people living in Japan – there are some areas where there are hardly any people living, and cities where there is not enough room. The children were directed to the statement at the bottom of the page, “There is a lack of space in Japanese cities. What can be done to create more space for people living in Japan?”

The class were then asked what type of thinking skill they could use to help them with the question, to which the majority of children responded ‘problem solving’. Children were directed to look at the problem solving thinking diagram on the other side of their sheet, and encouraged to work through the thinking steps on it. The teacher then asked the children what else they could do to help them do the best thinking possible, and the children gave answers such as planning, monitoring, redirecting and evaluating thinking (the teacher asked for examples for each of these and requested that the pupils give reasons stating why each of these stages is important). The teacher reminded the children of the dispositions that she would be looking for in each of them. She then directed the children to refer to the maps, posters and information sheets and to try to think up a solution to the problem. The children then worked individually on the thinking diagrams.

The plenary of the lesson involved individuals feeding back possible solution strategies that they had thought of. The teacher offered praise such as, “That solution strategy was well thought out”. She asked children for the individual thinking steps

that they had conducted in their heads and reminded them of the thinking dispositions that they should have been focusing on throughout the lesson. She then asked the learners to reflect on how successful their thinking had been throughout the lesson by evaluating it with the formative assessment technique, ‘show of thumbs’. She concluded the lesson by asking the class what they had learned in the lesson.

7.7.12 Teacher Intervention Evaluation Questionnaires

In addition to receiving feedback at the training day in the middle of the intervention, the experimental teachers’ completed evaluation forms of the intervention as a whole provided the teachers’ perspective on the intervention (see Appendix E for detailed comments from teachers). All four teachers in the experimental classes cited that they and their classes had enjoyed the thinking skills lessons and that it was a very positive, beneficial and interesting experience for teachers and pupils. One factor highlighted by all teachers as being central to the success of their lessons was the in-depth training they received, including the opportunity to observe each thinking skill lesson before they were required to teach it. This increased their confidence and ability to teach ‘effective thinking’ lessons.

All teachers felt that the intervention had successfully deepened their knowledge of thinking skills, and two of the teachers believed that their own thinking skills had improved as a result of the intervention (for example, they now were more aware of the processes involved in ‘good’ problem solving). In general, the teachers believed that the intervention had made a positive impact on children’s thinking dispositions, particularly that the children were now more likely to persevere and try harder when faced with challenging tasks. Without exception, all four teachers cited the main difficulty with the intervention was the time taken to incorporate ‘effective thinking’ lessons into the curriculum, as the lessons typically took longer than would normally have been spent in each curricular area. Both teachers of the individual learning classes stated additional difficulties in terms of having to ensure their children worked on the thinking skills in isolation.

All four teachers stated that their classroom practice had changed as a result of the intervention. For example, the teachers involved with the collaborative learning classes felt that they were now more confident about managing group work successfully within their classroom practices. Also as a result of the intervention the general view was that the importance of giving children ‘thinking time’ was now recognised.

In terms of recommendations made by the teachers for future interventions, some suggestions included focusing less on the thinking diaries, which many children found laborious towards the end of the intervention. The suggestion was also made that in the future, the intervention could be more spread out throughout the course of the school year. As a result of being involved in the pilot, all four teachers stated their intention to continue to teach thinking skills explicitly in a variety of curricular areas.

7.8 Discussion

Firstly, global changes detected in relation to the research questions will be discussed, first from the child data and then the teacher data. This discussion section will therefore concentrate initially on general trends evidenced as a result of the intervention and then focus on the implications for incorporating collaborative learning into effective thinking lessons. The teachers’ role within the intervention will then be discussed.

Pre- to post-test change

Overall, the intervention was highly productive with both experimental conditions benefitting more than the control condition across a variety of measures. A number of positive messages have arisen from this experimental study, the most important being that an intervention can be structured to increase children’s thinking skills, regardless of whether the teaching pedagogy promotes collaborative learning or not. Furthermore, the learners were exposed to a variety of fundamental thinking skills as identified in the introduction, representing skills from the core thinking types of searching for meaning skills, creative and critical thinking skills, decision making

and problem solving. Learners in both experimental conditions significantly improved their ability to utilise the language of thinking (as measured on the qualitative tests of good thinking), apply thinking skills, metacognitively reflect on their thought processes and identify opportunities where they could use those skills in other contexts (as evidenced by the Thinking Skills Assessments Versions 1 and 2 and the weekly ITs). These findings indicate that the intervention had been extremely successful in developing the underpinning pedagogy of effective thinking lessons as recognised by many theorists (e.g., Beyer, 1991, 1997; Kirkwood, 2005; McGuinness, 2003; Swartz & Parks, 1994; Tishman, Perkins, & Jay, 1995).

One of the main research questions for this study related to whether children's thinking skills and concepts of thinking could change as a result of a concentrated intervention. Whilst there was an improvement seen in a variety of outcome measures, the most significant increase was evident in the Thinking Skills Assessments that were created to measure specifically the thinking skills being taught. As Beyer (1987; 2001c) and Kirkwood (2005) advised, these tests assessed thinking skills from a variety of perspectives, with learners being asked to define and recognise each skill, apply it in a number of different contexts, identify the metacognitive processes they had used and then identify opportunities to transfer the skill to other contexts. The use of specific thinking skills assessments will be discussed further in Chapter 8. However, data indicated that children in both intervention conditions had improved on each of these aspects. The use of two versions of the thinking skills assessments, where the children had to apply the skills in different contexts, suggests that there had been an increase in children's ability to use the skills. This finding, plus the fact that a condition effect was found between the individual and the collaborative learning condition, suggests that the increase in performance was not simply as a result of the children rote-learning the skills.

The incorporation of the ITs clearly indicated that children's improvement in these thinking skills was immediate and sustained. There was a strong positive correlation between weekly performance during the intervention and the overall thinking skills improvement. This suggests that the extent to which children engaged with the task

during the intervention weeks was an important factor in determining their subsequent performance and ability on later occasions.

The intervention also considered children's concepts of effective thinking. Whilst a variety of research has been conducted to determine children's theories about intelligence (Dweck, 1999; Kurtz-Costes et al., 2005; Yussen & Kane, 1985), the introductory chapters to this thesis highlighted the lack of comparative research that identifies children's concepts of effective thinking. In addition to highlighting children's understandings of this concept, the results from this study also indicated that the intervention successfully challenged these concepts and raised awareness of what it means to be a 'good thinker'. These findings will be discussed in more detail in Chapter 8.

In general, analysis of the individual factors within both the MALS and the ALCP did not highlight any clear trends. This could be a reflection that, as the individual factors within each of these measures related to a variety of concepts, the intervention condition's responses were similarly variable. Furthermore, these assessments are standardised tests and not designed specifically for this intervention. The difficulties in assessing thinking skills with standardised tests were discussed briefly in the introduction to this chapter (De Bono, 1976; Wilson, 2000). Whilst these particular measures were chosen because of their relevance to this study (e.g., focusing on problem solving and higher order thinking), related concepts were covered only in a very general way. For example, when the factor 'Higher Order Thinking' within the ALCP is scrutinised (and on which the control condition performed better than either of the experimental conditions), it becomes evident that this factor does not address some of the core aspects of 'higher order thinking'. To clarify, examples of questions within this scale (e.g., 'My teacher helps me think carefully about what I'm learning so I can remember it', and 'My teacher explains things in different ways so that I understand') reveal tenuous links with the definitions of higher order thinking discussed in the introduction to this paper. The questions within this scale do not make any reference to particular groups of thinking skills or dispositions, nor explicitly refer to thinking processes connected to

metacognition and self-regulation. Had the ‘higher order thinking’ sub-scale more clearly reflected the definition of thinking skill found within many of the thinking frameworks previously discussed, the finding that the control condition perceived their teachers as fostering this more than the other two conditions would have been more surprising.

Similarly, for the sub scale ‘positive relationships’ the data indicated that the control condition’s mean score was significantly higher than the individual learning condition’s mean score. This is perhaps a reflection of the fact that, during the intervention, the individual learning classes were instructed by their teachers to work in silence and not to discuss any of the activities. Most of the children found this quite hard and the teachers of these classes had to continually reinforce this rule. Furthermore, the experimental teachers, perhaps due to the increased workload, whilst they enjoyed the lessons, were conscious of ensuring their classes took part in the intervention properly and followed the intervention instructions carefully. This could have had the affect of making them more stressed than the control teachers, something which could quite possibly have affected the children’s view of the extent to which positive relationships were fostered.

Collaborative learning

The other main research question raised the issue concerning the merits of adopting a collaborative learning approach over individual learning with the goal of enhancing children’s thinking skills. As discussed in the introduction, the majority of thinking skills packages encourage the incorporation of collaborative learning into lessons. However, as yet, little research exists to support this inclusion. This study therefore sought to gather more data on the question of whether providing opportunities to collaborate enhances thinking skills ability. The general trend apparent was that the collaborative learning condition was more successful than the individual learning condition. This was most clearly reflected in the weekly ITs where the collaborative learning condition performed significantly better than the individual learning condition on all thinking skills learned. In terms of the overall gain in individual thinking skills (as measured by the Thinking Skills Assessments Versions 1 and 2),

although in general the children in the collaborative learning condition performed better than those in the individual learning condition, typically this difference was not significant (although both conditions performed significantly better than the control condition). It should be noted, however, that the collaborative learning condition appeared more motivated than the individual condition. It should also be noted, that this study did not attempt to reveal the learning processes underpinning collaborative learning, or the underlying skills associated with its success. The implications of these findings related to collaborative learning will be discussed in more detail in the final chapter of this thesis.

Teachers' role in the intervention

The results also showed that the impact of the intervention influenced teachers' concepts of intelligence (including whether they view intelligence as fixed or malleable) and effective thinking. This intervention was therefore extremely successful in challenging previous assumptions (which were highlighted in the pre-tests of this study but also from the findings presented in Chapters 4 and 5). These changes will be discussed in more detail in Chapter 8 and with relation to Studies 1 and 2.

The fact that data from the pupil measures highlighted improvements in the way children understand 'good thinking', and their ability to recognise and apply thinking skills in lessons, suggests that for this to have occurred, the teachers must have significantly changed the way they taught lessons. Classroom observations, video evidence and qualitative comments from the teachers indicated that, without exception, all four teachers felt that their knowledge of the elements involved in good thinking and individual thinking skills, the processes involved for each of the thinking skills, the importance of developing the language of thinking, thinking dispositions and metacognition had been heightened.

The lessons observed during the intervention indicated that the teachers were delivering 'effective thinking' lessons supported by the handbook. However, the post-test videos for all four experimental teachers provided compelling evidence that

the elements of effective thinking lessons on which the teachers were trained specifically for the intervention had become integrated into each experimental teacher's methodology. As a result of the intervention, the experimental teachers demonstrated that they were all able to infuse elements of the underpinning pedagogy of effective thinking (as discussed for example in Chapter 3 of this thesis) into areas of the curriculum, without needing to follow structured lesson plans. This suggests that, whilst the intervention was relatively short, as it was so focused and as the teachers were trained extensively following a model that incorporated reflection, evaluation and adaptation, that the effects of the intervention could potentially continue long after the intervention has finished. The lesson plans in the handbook provided a prop and were a way to ensure similarity between the experimental groups. However, the findings indicated that by the end of the intervention, the structure and essence of typical lessons taught had altered from knowledge-based to being centred on active thinking and learning, something which potentially could have a long-term effect. One of the most important aspects of this study is therefore that it does not need to be adapted for practice as the entire intervention has already been used in an educational setting and proved to be extremely successful. The handbook (consisting of the rationale, framework, lesson plans, thinking diagrams, flashcards, prompts and key steps posters) is a resource that can be developed easily for teacher training and support. Whilst teachers may initially rely heavily on the handbook, this intervention has shown that when adequate training for practitioners is provided, the methodology from these intervention lessons transfers into teachers' daily classroom practices, a view supported by both McGuinness (2000a, 2000b) and Adey (2006). These findings have implications for the way in which teachers are introduced to new initiatives and will be discussed further in Chapter 8.

7.8.1 Conclusions

This study explored the effects of an intervention designed to increase children's thinking skills. Findings indicate that when thinking skills are taught explicitly, children learning them either individually or collaboratively in groups will improve. However, children practising the thinking skills collaboratively tended to score slightly higher in general and experience more task motivation. To detect this

change, this study made an important contribution to the way in which thinking skills are assessed; measures used must be sensitive enough to detect change as a result of the intervention. This study is able to make a unique contribution to the field of teaching thinking skills. Whilst other studies have focused on assessing general cognitive abilities as a result of implementing a particular package, the present study shows that learners can improve in their deployment of the underpinning principles of effective thinking when they are infused within curricular areas. When taught explicitly, learners can develop thinking vocabularies, apply thinking skills, reflect on their thought processes metacognitively and recognise when to generalise the skills to other areas.

Furthermore, in general, the methodology adopted in this study whereby the teachers underwent in-depth training (which included the teachers observing each type of thinking skill lesson before they had to teach it from a structured lesson plan) was fundamental to the success of the intervention. As well as adding to the literature on collaborative versus individual learning, these findings have implications for the way in which teachers are introduced to new initiatives; to ensure sustainability there needs to be an on-going fully supported model of training, trial and reflection.

The final chapter of this thesis, Chapter 8, draws together the results of the three empirical studies reported in this thesis in an attempt to unite teachers' and pupils' concepts of effective thinking and intelligence, and to make a contribution to our understanding of the importance of gathering baseline information before intervening to effect change. The importance of promoting an 'effective thinking' generic lesson template in learning establishments will be discussed, making reference to existing methods of assessing improvement in thinking skills. The issues that have arisen throughout the course of this thesis have many practical implications. These will also be discussed in the concluding chapter.

CHAPTER 8

GENERAL DISCUSSION

8.1 Aims of this Thesis

It was the aim of this thesis to further our understanding of teachers' and pupil's conceptions of effective thinking, and to effect change by designing an intervention to modify those conceptions and develop pupils' thinking skills. The intervention specifically trained teachers to infuse thinking skills into a variety of curricular areas, and the intervention was assessed in terms of thinking skills taught and the effects of collaborative learning. In classrooms, learners are commonly urged to 'think harder', and empirical work from this thesis focused on determining if both teachers and pupils understand how to change their own cognitive processes. Whilst Studies 1 and 2 identified teachers' and pupils' understandings of thinking skills, the third study was an experimental one designed to find out if a structured and concentrated intervention could challenge these understandings by training practitioners to teach for thinking explicitly.

It is the purpose of this chapter to highlight broad themes that have emerged from the results of the three studies presented in this thesis. Emphasis will be placed on the key findings and these will be integrated and examined in comparison to other research and with respect to implications for educational theorists, policy makers, practitioners and children.

8.2 Summary of Key Findings

Study 1

Chapter 1 revealed that opportunities to encourage children to think were promoted in the 5 – 14 Guidelines, albeit indirectly. It was therefore important to establish

teachers' experience of this so that stronger links could be made between established practice resulting from the 5 – 14 curriculum and new policy developments such as the National Priorities in Education and *A Curriculum for Excellence (2004)*. The findings from this study are arguably important as they show that practitioners are uncertain about what is meant by 'effective thinking', and just under half of the respondents defined it within the category of 'knowledge'. A number of frameworks for understanding thinking skills have also been discussed (see Chapter 1). The framework by McGuinness (2003) was used as a theoretical basis for a large part of Study 1 as it was seen to promote the most fundamental cognitive skills and strategies (although McGuinness intends the framework to be used within a wider pedagogical effective thinking framework, encompassing more than thinking skills). Study 1 also investigated the frequency of thinking skills being taught and identified the curricular areas (from the practitioners' perspective) in which they are integrated most successfully. Although teachers perceived critical thinking skills to be taught most frequently, within all thinking types (critical thinking, creative thinking, searching for meaning, decision making and problem solving strategies) there does not appear to be a broad range of thinking skills being taught consistently across the curricular areas. Of most relevance for Study 2 was the finding that teachers did not appear to tailor their teaching of thinking skills to the developmental abilities of children in their classrooms. Data from the first study therefore indicated that practitioners believed opportunities were being provided within learning environments to develop children's thinking skills.

Study 2

Study 2 followed on from the previous one by investigating children's perceptions of thinking skills, by delving more deeply into their concepts of intelligence and determining their understanding of the elements involved in 'good thinking'. Traditionally, in schools learners appear to rate being clever as a valid goal, and associate 'cleverness' with knowledge acquisition. This study therefore sought to find out whether children associate intelligence specifically with knowledge or perhaps thinking skills and dispositions. Furthermore, whether they view intelligence as a malleable construct that can be increased through effort, motivation,

applying thinking skills and dispositions (e.g., Cain & Dweck, 1995; Dweck, 1999; Stipek & Gralinski, 1996). The results indicated that, whilst younger children tend to associate cleverness with non-cognitive characteristics, with age, these concepts change to reflect more knowledge-based understandings of cleverness. Learners therefore did not view ‘cleverness’ as being synonymous with ‘good thinking’ but with knowledge. Similar age trends were not apparent in children’s definitions of ‘good thinking’. The lack of a correlation between these two concepts suggests that children do not see the link between becoming more intelligent and developing their thinking skills. Furthermore, because findings from Study 1 suggested that practitioners are not yet working within a clear structure and progression and teaching age-appropriate thinking skills, Study 2 gathered developmental data to discover if children’s understanding of individual thinking skills is linked to age. Findings indicated that older children had a better understanding of individual thinking skills than younger children.

Study 3

Having discovered more about teachers’ and children’s understandings of effective thinking, this final study aimed to challenge those perceptions through a structured intervention. Permeating each lesson was the assumption that intelligence is malleable. The format for the intervention lessons was based on the core elements of effective thinking as identified by the majority of theorists (particularly those in support of the infusion method) and as such, the teachers and children were trained in the importance of making the thinking explicit, developing thinking dispositions, fostering metacognition and transfer (e.g., Beyer, 1991, 1997; Kirkwood, 2005; McGuinness, 2003; Swartz & Parks, 1994; Tishman, Perkins, & Jay, 1995). This intervention study also gathered data on the most effective way to enhance thinking skills; either through individual or collaborative learning. Findings from this study highlighted the benefits when teaching children to think explicitly, and those outcome measures designed specifically for the study showed the greatest gains. Results showed improvements in children’s ability to apply, in different contexts, the taught thinking skills (i.e., comparing & contrasting, grouping, finding reasons & conclusions, coming up with ideas, making decisions and solving problems). Also,

as a result of the intervention, by the post-test learners were incorporating thinking skills into their definitions of ‘cleverness’ and ‘good thinking’. Perhaps the most interesting finding from this study is that, whilst children in the collaborative learning condition appeared to enjoy the intervention more and performed better on most measures, both the individual and the collaborative learning condition improved significantly from their baseline measurement of thinking skills and more than the control group.

8.3 Identifying Baseline Perceptions of Thinking Skills

From the outset, this thesis has worked under the premise that before experimental work in educational environments can be considered, an understanding of current practice and perceptions must be gathered. In this respect, Studies 1 and 2 were fundamental to the success of Study 3 as they ensured that teachers’ and pupils’ concepts had been identified prior to the formulation of the intervention study.

For example, findings from the first two studies in this thesis reflected the need for the intervention study to challenge and develop practitioners’ and children’s knowledge about ‘good thinking’, and highlighted the importance of raising awareness that intelligence is not a stable trait, but one that can be cultivated (e.g., Dweck, 1999; Fogarty, 2001; Sternberg, 1987a). In addition, data from Study 2 indicated that children were viewing intelligence and effective thinking as two separate concepts (i.e., the majority of primary 7 pupils associated intelligence with knowledge but were less certain of how to define effective thinking); they were not associating the two phenomena with similar cognitive capabilities. Furthermore, the baseline data gathered from the second study was crucial in establishing how children view intelligence, (something which many theorists believe affects the way children learn e.g., Dweck & Bempechat, 1983; Sternberg, 2000; Sternberg & Grigorenko, 2000, see Chapter 2 for an overview) and effective thinking (on which there has been little attempt made to discover children’s understandings, but which is also inextricably linked to the way children learn). Data also indicated that thinking skills were not integrated into all areas of the curriculum equally.

This data collection and analysis was invaluable for Study 3 as it highlighted that, whilst by the end of primary school the majority of children are uncertain about what constitutes ‘good thinking’, they have a sufficiently developed knowledge of the individual thinking skills investigated in Study 2 that were used as the basis for Study 3. Therefore, one of the most valuable messages from the first two studies was that in-depth training would be necessary if teachers’ and children’s concepts were to be challenged. The staff development devised for the experimental teachers in Study 3 was tailored to the needs identified from the first two studies. Within the field of thinking skills, this thesis can be said to break new ground as it is one of the first of its kind to examine teachers’ and pupil’s perceptions of thinking skills, and use those findings to structure an age-specific intervention.

8.3.1 Understanding Age-Appropriateness of Thinking Skills

Chapter 1 discussed one of the main difficulties facing practitioners when teaching thinking skills as a whole school approach; whilst there have been numerous attempts to categorise thinking skills into frameworks (Anderson & Krathwohl, 2001; Marzano, 2001; Halpern, 1997; Moseley et al., 2005; Pintrich, 2000), the lack of frameworks which guide and support practitioners to teach a clear progression of thinking skills from early years through to further education was evident. In this respect the data reflects Beyer’s criticism (2001b) cited in Chapter 1.

The findings from Study 1 provide further support for this requirement. Although, in general, whilst practitioners were shown to be teaching a fairly varied set of thinking skills across the majority of curricular areas, they did not appear to be doing so developmentally. This finding was not unexpected considering the relative newness of the initiative and previously discussed lack of guidance on thinking skills progression for education. However, the profile of this finding was raised considerably when findings from Study 2 highlighted a striking age trend in children’s knowledge of thinking skills, representing the main types of thinking as discussed in the introductory chapters (i.e., creative and critical thinking, searching for meaning, decision making and problem solving).

By the time children reach secondary school (i.e., 11/12 years of age), data from Study 2 suggests that the majority of children have a clear understanding of core thinking skills, whereas younger children are not aware of what it means to think up ideas, give explanations, make careful decisions and solve problems well. However, children at all ages were shown to have an understanding of the thinking skill 'sorting'. This finding was not surprising as current curricular guidelines explicitly promote the inclusion of this skill in a variety of subject areas (e.g., Scottish Office Education Department, 1991a). This implies that if more emphasis is placed on developing children's thinking skills throughout the formal curriculum from an early age, learners would have a better knowledge of a variety of thinking skills which could be built on from early to upper primary.

Within all curricular areas guidance is currently given to practitioners on how to teach for progression and continuity (as discussed in more detail in Chapter 1). The 5 – 14 guidelines were particularly clear on how this should be done within the main curricular areas. *A Curriculum for Excellence* (2004) encourages practitioners to work outwith these previously identified constraints of the 5 – 14 curriculum. However, the progression and resulting resources and schemes from the 5 - 14 era has meant that children's abilities are developed and tailored to cognitive abilities to a certain extent through the explicit guidance 5 – 14 documents provide on how to teach subject content age-specifically. It is important in ensuring the sustainability of the 'thinking skills initiative' that more in-depth research is gathered to produce a list and corresponding exemplars of age-appropriate thinking skills. Since age-trends were discovered in children's understanding of individual thinking skills, teachers need to incorporate this knowledge into their daily practices. The findings from this thesis in this respect support Beyer's view (highlighted in the introductory chapter to this thesis), that practitioners need support to identify appropriate thinking skills to teach at different ages (2001a, 2001b).

Clearer guidelines are therefore required and the promotion of a thinking skills framework within which practitioners can identify the most important and age-relevant thinking skills. To support practitioners with this task, the utilisation of age-

specific generic resources such as thinking diagrams was found in Study 3 to allow teachers to infuse the thinking skills into a variety of different curricular areas. Using thinking diagrams has the advantage of ensuring that progression within thinking skills is not viewed as being separate from progression within other curricular areas requiring active learning, as the same generic thinking skill diagrams allow and reinforce transfer in other subject areas. These findings thus support the view of those theorists cited in Chapter 3 who support the inclusion of thinking diagrams into teaching practices (e.g., Beyer, 1997; Clarke, 1991; Hyerle, 1991; Kirkwood, 2005; Nessel & Baltas, 2000; Perkins et al., 1994). It seems important that teachers' awareness is raised that development in other curricular areas can be enhanced by the integration of thinking skills. Whilst Swartz and Parks (1994) have made a start to devising age-appropriate thinking diagrams as a means of developing age-specific thinking skills, more work needs to be conducted before the diagrams are able to support developmental progression sufficiently when teaching for thinking.

8.3.2 Conceptions of Effective Thinking and Intelligence

Teachers' Concepts

In the introductory chapter of this thesis a review of expert's understanding of intelligence and effective thinking respectively highlighted the lack of a single commonly accepted definition. Some abilities (e.g., reasoning and problem solving) were present in many of the definitions, however (Gottfredson, 1997; Sternberg & Wagner, 1986; Synderman & Rothman, 1988). As contemporary experts in the field find it intrinsically difficult to define and identify abilities particular to effective thinking, it was not unexpected to find data from this thesis indicating that practitioners also find it extremely complex. Just under half of the teachers surveyed in Study 1 did not define 'effective thinking' as involving specific thinking skills, strategies and dispositions, with many practitioners in Study 1 linking it with knowledge. These findings give more weight to the theorists discussed in the first chapter of this thesis who believe that, for too long, the imparting of knowledge has been a central aim of education (Ashman & Conway, 1997; Costa, 1989; Resnick &

Klopfer, 1989a). Perhaps the effects of this weighting can still be seen in current educational establishments. The findings from this thesis also complement those of Paul, Elder and Bartell (2004), who found that only 19% of lecturers interviewed could give a clear explanation of effective thinking (n = 140). Furthermore, Chapter 7 highlighted that all four teachers involved with the intervention from Study 3 strengthened their belief that intelligence was malleable by employing various thinking skills and dispositions. This had the effect of strengthening teachers' understanding of the link between the two phenomena (intelligence and effective thinking), something which Paul et al. suggest the majority of practitioners do not connect (2004, p. 7):

...the central problem is that most faculty have not carefully thought through any concept of critical thinking, have no sense of intellectual standards they can put into words, and are, therefore, by any reasonable interpretation, in no position to foster critical thinking in their own students or to help them to foster it in their future students – except to inculcate into their students the same vague views that they have.

This thesis attempted to alleviate these concerns first by identifying teachers' concepts of effective thinking, and then by intervening through structured in-depth sessions, to deepen teachers' awareness of the link between intelligence and effective thinking and the elements involved in each. The intervention study reported in this thesis therefore followed the advice of theorists such as Swartz (1987), who believes that it is crucial to develop teachers', "deep conceptual understanding of specific attitudes and skills" (p. 117) concerning effective thinking, before attempting to portray these concepts through teaching methodologies. Swartz has called this the 'conceptual-infusion' approach:

This involves focusing [the teachers'] attention on and thinking through what the ingredients in good thinking are – the skills, competencies, attitudes, dispositions, and activities of the good thinker – and then developing lessons to enhance the development of these through the restructuring of what they already teach.

(1987, p. 125)

These findings have important implications for the classroom practices to which learners are exposed daily. In Chapter 2, the effect that teachers' implicit theories of intelligence have over daily routines such as assessment, feedback and ability groups was discussed. If current views within this field are to be accepted, then it is not surprising that, since teachers' concepts of intelligence changed to reflect their awareness of the correlation between intelligence and effective thinking, there was a similar change in children's, as evidenced in Study 3 (Pretzlik et al., 2003; Rosenholtz & Rosenholtz, 1981; Stipek, 1981; Stipek & Tannatt, 1984). It can be assumed that teachers' views of effective thinking are transmitted in a similar way to learners. The findings from this thesis (that practitioners are uncertain of the key elements involved in effective thinking) contribute to our understanding of why learners find the concept so difficult to define. Furthermore, they echo the request made by other theorists that further research needs to investigate the link between teachers' concepts, classroom practices and learners' concepts (e.g., Kember, 1997; Pithers & Soden, 2000), as teachers' beliefs are widely accepted to influence task content and interaction in the classroom (e.g., Torff, 2005). In a similar vein, the findings from this thesis imply that it is important that teachers become aware of children's concepts and beliefs (Watkins, 2004).

Yet even more important than the finding that practitioners are uncertain of the skills, abilities and dispositions involved with effective thinking, and many still associate 'knowledge' with intelligence, is the encouraging finding from Study 3 that, when appropriate measures are put in place, these theories about intelligence and effective thinking can be challenged successfully. In this respect these data expand that of Torff, (2005), and Entwistle, Skinner, Entwistle et al. (2000) who noted the difficulties with developing teachers' beliefs. The way in which teachers' concepts were challenged was conducted through an in-depth process of training and support, which encouraged teachers to perceive the link between the malleability of intelligence and effective thinking skills and strategies. It is possible that many teachers hold views that have been acquired without much thought, because they are a product of the society and culture in which they are based (Rosas, 2004; Shi, 2004; Sternberg, 2004). As Dearden notes, it is possible to hold a belief which has,

“...come to rest in the mind, as it were, or casually lodged there, without the intervention of any process of critical discernment” (1984, p. 118). Research from this thesis therefore has implications for the way in which teachers’ and learners’ concepts are challenged, as teachers’ own beliefs (and reasons underpinning them) must first be detected.

Children’s Concepts

Chapter 2 of this thesis discussed the importance of teachers’ implicit theories and how these theories have the ability to affect their actions, feedback to learners and general classroom practices. It was therefore not surprising when combined data from the second and third studies presented in this thesis reinforced the view that children’s implicit theories often mirror those of their teachers; that is, prior to the intervention, children had a limited understanding of the processes involved in effective thinking, and many tended to incorporate knowledge into their definitions of intelligence. Whilst this was not a primary aim for investigation throughout this thesis, the findings gathered support the view of those theorists who believe that teachers’ views and theories affect learners (Rosenholtz & Rosenholtz, 1981; Stipek, 1981).

In a similar way to the teacher data gathered, findings from this thesis also support the belief that knowledge acquisition has been overemphasised in schools. By the time children reach secondary school, findings from Studies 2 and 3 indicate that the majority of learners associate intelligence with knowledge. This finding also gives support to Perkins’ belief (1992) that for too long the educational system has made achievement in examinations synonymous with effective memory recall. The majority of older respondents (11 yr olds) from Studies 2 and 3 (pre-test data) defined intelligence as knowledge, and noted the characteristics or signs of intelligence also as being linked to knowledge. When questioned about how they could become more intelligent, whilst the majority of 11 year olds (primary 7 pupils) in Study 2 cited the passive activity of ‘good citizen’ (i.e., listening to the teacher, not talking in class), the majority of pupils questioned in the Study 3 pre-tests did not know how to become more intelligent. Findings from the intervention study indicate

that these identified conceptions of intelligence were successfully challenged, with all children benefiting as a result of the intervention and indicating that they were including thinking skills and dispositions into their definitions and characteristics associated with intelligence; they were able to see the link and were no longer viewing them as discrete concepts.

Whilst the findings from Studies 2 and 3 (the pre-test data) regarding children's concepts of intelligence echo findings from other well-documented studies (Kinlaw & Kurtz-Costes, 2003; Kurtz-Costes, et al., 2005; Yussen & Kane, 1985), there is little research with which to compare children's concepts of effective thinking. The older pupils' responses from Study 2 and data from all respondents in Study 3 (prior to the intervention), indicated that the majority of all learners were not able to define or describe 'good thinking', nor were they able to identify the characteristics associated with thinking effectively. Similarly, the majority of children in Study 3 pre-intervention were unable to pinpoint how to become better thinkers. In addition to highlighting children's understandings of this concept, the results also indicated that the intervention successfully challenged these concepts of effective thinking (in addition to challenging their concepts of intelligence). Data from the post-tests highlighted a striking improvement in the experimental condition's awareness of the core elements of effective thinking. As a result of the intervention study, children in both of the experimental conditions were able to associate 'good thinking' with the ability to use and apply thinking skills and strategies (such as coming up with original ideas, coming to conclusions based on evidence, making good decisions and solving problems skilfully) and dispositions (e.g., persevering at challenging tasks). The intervention therefore succeeded in deepening children's concepts about the elements involved in being a 'good thinker', and simultaneously an improvement was seen in both intervention conditions' more developed language of thinking. As a result of the intervention, children in the experimental conditions were better able to understand thinking skill concepts and more aware of the processes to apply in order to improve their thinking. This echoes Resnick's argument about one of the advantages of adopting the infusion method (1987, p. 36):

...embedding higher order skill training within school disciplines provides criteria for what constitutes good thinking and reasoning within the disciplinary tradition.

Just as the teachers' views of intelligence and effective thinking altered by the end of the intervention, so the pupils' identified concepts from Study 2 and baseline perceptions from Study 3 were challenged as a result of the intervention and learners had become aware of the processes they employ in their heads to become better thinkers. An interesting finding from Study 3 regarding the change in children's views of intelligence was that the children involved with the collaborative learning condition were the only ones to alter their beliefs significantly and move towards holding incremental views of intelligence.

These data therefore indicate that through a focused intervention children's understandings of intelligence and effective thinking can be challenged. It is possible that the intervention informed their implicit theories and could be a reason for this substantial increase on their performance on the thinking skills tasks; by the end of the intervention children understood that it was within their ability to become more intelligent, and more importantly, they knew *how* to become more intelligent. In this respect the data presented in this thesis could support Dweck's work which suggests that children's implicit theories affect confidence and task-motivation (Dweck, 1986, 1990, 1999). Furthermore, as Resnick notes, "incremental conceptions of ability and associated learning goals lead children to analyse tasks and to formulate strategies for overcoming difficulties" (1987, p. 43). This brings together the link between conceptions of intelligence, effective thinking, motivation, thinking skills and dispositions, and she argues that:

...these lines of motivation research highlight the possibilities for an important convergence between efforts aimed at teaching higher order cognitive skills and those aimed at cultivating dispositions to apply those skills.

(1987, p. 44)

8.4 The Underpinning Pedagogy of Effective Thinking Lessons

Findings from the first two studies indicate that children are being exposed to thinking skills representing the core thinking types identified in Chapter 1 (i.e., critical and creative thinking, searching for meaning, decision making and problem solving) fairly frequently, and that by primary 7, the majority of pupils have a solid understanding of some key thinking skills. However, these studies did not show *how* the thinking skills were being taught to children. For example, the pupils may not have been aware of the thinking skills that practitioners claimed to be teaching regularly in a variety of curricular areas in Study 1. Teachers may have been covering them only in an indirect way and not being explicit enough to children about the thinking skills and processes that they were asking them to employ. As discussed throughout this thesis, teaching thinking explicitly is something that many theorists strongly believe represents the essence of the ‘teaching for thinking’ initiative (e.g., McGuinness, 1999; Resnick, 1987; Swartz, 1987). Perhaps if the thinking processes were being focused on more regularly in classrooms, then from an earlier age children would have a better understanding of the core elements involved in fundamental thinking skills.

For the intervention study, the method by which learners were exposed to thinking skills was closely based on the rationale underpinning the ‘Thinking Curriculum’ (Resnick & Klopfer, 1989a) by infusing thinking skills into subject content (McGuinness, 2000a, 2000b, 2003; Swartz, 1987; Swartz & Parks, 1994). The justification for adopting this method was put forward in Chapters 3 and 6; it involved training teachers on a slightly different pedagogical slant than they had previously been adopting, rather than familiarising teachers with a particular pack of lessons.

Teaching Thinking Skills Explicitly

Study 3 was devised to teach for thinking explicitly, providing in-depth training in the cognitive processes involved in each of the thinking skills covered throughout the intervention. The training was in-depth for both the practitioners and the learners. Many of the comments made by the intervention teachers during the training days

and evaluative questionnaires highlighted their lack of knowledge of the processes underpinning various cognitive strategies they often employ. For example, both teacher and pupil data indicated that, whilst decisions were often made and problems ‘solved’ to a certain extent, they were perhaps not fully aware of the explicit stages involved to enable them to make ‘careful’ decisions and solve problems ‘skilfully’ (see Chapter 7).

Findings from the final study reported in Chapter 7 of this thesis indicated that the intervention had been successful as the majority of learners involved with the intervention understood the processes behind the thinking skills. Therefore the feature of each effective thinking intervention lesson whereby the skill steps and processes were made explicit were fundamental to this improvement. In this way, the data gathered from the intervention study in this thesis supports Resnick’s view that, “Elements of thinking are clearly teachable” (Resnick, 1987, p. 46). This was evident from the scoring of the Thinking Skill Assessments and ITs. These were marked on a 1 – 5 scale, and a scoring of ‘5’ meant that the pupil displayed an in-depth understanding of the processes involved in that skill. For example, in a decision making question, a scoring of ‘5’ meant that the pupil’s working highlighted them first thinking up alternatives, then considering some of those alternatives in regard to consequences, pros/cons, importance of consequences before finally coming to a considered decision. This finding backs up Swartz and Parks’ (1994) and Beyer’s (e.g., 1987; 1988; 1991) belief that making the thinking processes explicit to the learners is a crucial part of all effective thinking lessons.

An integral part of making thinking explicit is using appropriate and specific thinking words to further expand learners’ understanding of the cognitive steps to take when instructed to ‘think harder’ (Tishman & Perkins, 1997; Tishman et al., 1995). In Chapter 3 the importance of developing an extensive vocabulary of thinking words, as part of the underpinning pedagogy of effective thinking lessons was discussed. For this reason, the teachers in Study 3 were given explicit training on why it was important and how an appropriate language can be cultivated in the classroom, following the advice of Tishman et al. (1995). Findings indicated that the

practitioners and pupils involved in the intervention significantly increased their thinking word vocabularies, and were able to demonstrate their use in appropriate contexts. Whilst this improvement could be one reason why applying thinking skills improves significantly in both intervention conditions, this is just speculation, as it is possible that the learners and teachers expanded their knowledge of individual thinking words but that this increased vocabulary did not impact on their actual thought processes.

Cultivating Thinking Dispositions

Chapter 3 also highlighted the belief which many theorists hold, that fostering appropriate thinking dispositions is as important as developing thinking skills (Beyer, 1987; Claxton, 2002; Costa, 2000; Perkins, Jay, & Tishman, 1993). The first two studies in this thesis examined teachers' and pupils' understanding of individual thinking skills. However, the fact that practitioners feel that they are teaching children thinking skills (Study 1), and acknowledging that as children travel through primary school they acquire a more developed understanding of what isolated thinking skills mean (Study 2), does not address the potential difficulty that these findings bear no relation to learners' propensity to use the skills in appropriate and relevant contexts (Tishman et al., 1995).

Although Study 3 emphasised the importance of modelling and fostering thinking dispositions that the intervention teachers believed the children in their classes would benefit from most (i.e., have a go, have fun, be persistent, be precise, take time to think and explore new ideas), the development of appropriate thinking dispositions was not a central aim of the third study, although it was an important subsidiary one. The extent to which the inclusion of the six thinking dispositions enhanced children's desire and inclination to use the thinking skills taught is not known. However, all intervention teachers reported that their pupils were much more willing to attempt challenging tasks and persevere as a result of the intervention. A note of caution must be heeded, however, as this increased motivation, confidence and perseverance could also be as a result of the learners now having a better understanding of the

individual skill processes (i.e., the thinking steps and strategies), rather than it being a result of them modelling appropriate thinking dispositions.

Developing Metacognition

Study 1 raised awareness that teachers believed that they were fostering the ability in learners to reflect on their thought processes and cognitive skills to some extent. The inference was made in Chapter 4's discussion section, however, that these opportunities are perhaps more teacher-led than pupil-centred. The importance of developing the ability in learners to reflect metacognitively on the application of cognitive skills is widely accepted to be one of the most fundamental aspects of intelligence and effective thinking (Beyer, 1987, 1997; Fisher, 2003; Grotzer & Perkins, 2000; McGuinness, 2005b; Moseley et al., 2005). A strong emphasis within Study 3 was placed on metacognition, encouraging learners to be metacognitively aware of their thinking at the three crucial stages; before, during and after tasks (Beyer, 1987; Borkowski & Thorpe, 1994; Brown, 1987; Costa, 2001). Feedback from the individually designed thinking skills assessments illustrated the inability of the majority of pupils to state any steps involved in their thinking processes prior to the intervention. After the intervention, all learners (from both experimental conditions) had greatly improved their ability to mentally reflect on the cognitive processes to apply when carrying out thinking tasks. This indicates a significant improvement in metacognitive ability. This suggests that an intervention can be structured which specifically develops learners' metacognitive ability, a key identified aspect of effective thinking. However, a note of caution must also be raised here. Findings indicated that learners had clearly improved at their ability to reflect metacognitively on the thought processes they had just undertaken. In many instances, pupils listed that they first, for example, planned their thinking before coming up with alternatives. However, this does not provide any evidence of them actually having planned and monitored their thinking (i.e., conducted the 'before' and 'during' self-regulative thought processes, see Chapter 1) before being asked to explicitly reflect on those processes. As Costa states (1981):

If we wish to install intelligent behaviour as a significant outcome of education, then instructional strategies, purposefully intended to develop children's metacognitive abilities, must be infused into our teaching methods, staff development, and supervisory processes.

(cited in Costa, 2001, p. 408):

Fostering Transfer

The value of being able to transfer thinking skills and strategies (and dispositions) to other contexts was discussed in Chapter 3. This ability, however, can often be underrated. For example, pupils are taught to read in schools so that they can use and apply that ability in their everyday lives. Pupils should be able to see the relevance of all skills learned in school and be able to identify how they can impact on their lives in general. Unfortunately, this is often not the case, with many children learning knowledge and aptitudes of which they do not see as relevant to their everyday lives. The intervention lessons devised for Study 3 were conducted with the aim of helping learners to visualise how it would be useful to apply the thinking skills in a variety of contexts (e.g., asking probing questions such as, "Where else would it be useful to compare and contrast?" and "Can you think of a time in the past when you should have thought about a decision you made more carefully?"). The difficulties with assessing transfer, however, were discussed previously in this thesis (Chapter 3) (e.g., Moseley et al., 2005; Resnick, 1987). Whilst Study 3 data clearly showed learners' (involved with the intervention) ability to identify opportunities where they could apply the skill in other contexts highlighting the successful impact the intervention study had made, it was outwith the scope of the third study to determine whether the learners were actually applying them elsewhere. What is implied from these findings, however, is that the intervention succeeded in raising children's awareness that the skills they learn in school have a place in their everyday lives, something which the majority of learners did not appear to be aware of prior to the intervention. Even without the guarantee of transfer occurring, Resnick believes that, when the infusion approach is adopted, the learners will still feel many benefits from the effective thinking lessons:

The decision to exercise thinking in every subject means that, even without transfer, students will have acquired thinking skills of many kinds, usable in many arenas of learning. Transfer, if we can find ways to produce it, will be a welcome additional benefit. But even without it – or with only limited amounts of it – the Thinking Curriculum can be a success.

(1987, p. 6)

8.4.1 Collaborative Learning

As discussed in Chapter 3, collaborative learning is a feature common to many thinking skills packages, despite there being little research to support this inclusion within the domain of thinking skills. This thesis therefore sought to gather more data on the question of the extent to which learners are provided with the opportunity to work collaboratively, and investigated whether providing opportunities to collaborate enhances thinking skills ability.

The first study in this thesis discovered practitioners' beliefs about the extent to which collaborative learning enhances children's thinking ability, their views on learners' preference for collaborative learning (versus their preference for individual learning) and the frequency with which they allow learners to work collaboratively. The majority of teachers surveyed cited that the effect collaborative learning has on children's thinking would be child, situation and subject-specific. Similarly, most of the practitioners believed that, whilst they prefer to have learners working individually (perhaps due to easier to manage classroom dynamics), that this would also depend on the situation. It was not surprising, however, to discover that teachers perceive learners as preferring to work collaboratively in classroom situations. These findings imply that teachers are struggling with trying to reconcile children's enthusiasm for collaborative learning with the inherent issue associated with collaborative learning regarding the impact on classroom dynamics. Furthermore, the prominent view that the effectiveness of collaborative learning depends on a number of factors was discussed in Chapter 3. For example, one study conducted by Ding and Flynn (2000) found that there were several factors that impacted on the effectiveness of collaborative learning: intersubjectivity, communication, planning

and inhibition. If children are unable to display and model each of these skills effectively, they believe the collaborative learning process will be affected negatively. Study 3 was designed specifically to measure the impact of collaborative learning versus individual learning. However, the classes working collaboratively and their teachers were not given any explicit training on the skills involved in collaborative learning, something which many theorists believe is central to its success (e.g., Ding & Flynn, 2000). The lack of specific training notwithstanding, the general trend apparent was that the collaborative learning condition was more successful than the individual learning condition, particularly evidenced by the ITs. In terms of the overall gain in individual thinking skills, although both experimental conditions out-performed the control condition, the difference between the two experimental conditions was in general not significant.

Two exceptions within the individual skills analysed were found for the skills ‘finding reasons and conclusions’ (a recognised critical thinking ability) and ‘coming up with ideas’ (representing a creative thinking skill). The collaborative learning condition was shown to be more successful at developing the skill of ‘finding reasons and conclusions’. This finding therefore supports Wegerif’s research discussed in Chapter 3 (Wegerif, 2000, 2001, 2002) which suggests that fostering classroom dialogue is fundamental to develop children’s ability to identify and articulate alternatives, evidence and reasons for beliefs. Furthermore, data from the intervention study concur with this as the children learning the thinking skills collaboratively demonstrated more advanced thinking word vocabularies than those children learning the skills individually.

Similarly, collaborative learning was found to be significantly more successful than individual learning when developing the creative thinking skill ‘coming up with ideas’. Chapter 1 of this thesis highlighted many theorists’ belief that this skill represents the essence of creative thinking. One possible reason for the finding that collaborative learning is a more successful vehicle than individual learning at developing this skill could be that ‘generating ideas’ or ‘brainstorming’ (the strategy by which ‘coming up with ideas’ is commonly known in classrooms) is widely

accepted to be enhanced through group-effort and sharing of ideas. This is based on the premise that one person's ideas can stimulate, trigger and further develop other people's (Cropley, 2001; Nickerson, 1999; Osborn, 1953; Swartz & Parks, 1994).

Developing children's metacognitive awareness is widely accepted to be central to the development of general thinking skills (Beyer, 1987, 1997; Fisher, 2003; Grotzer & Perkins, 2000). It was not surprising, therefore, to find that both intervention conditions significantly improved at reflecting on their thought processes in addition to developing their individual thinking skills. A large number of theorists believe that fostering opportunities for classroom dialogue and collaboration are fundamental to the development of metacognition (as the learners are encouraged to 'think aloud' and talk through their thought processes) (Beyer, 1997; Kirkwood, 2005; Tishman et al., 1995). Data from the metacognitive weekly ITs supports this view as the collaborative learning condition in general performed significantly better throughout the intervention than the individual condition. For this reason, it was unexpected to find that this gain was not maintained in the post-test thinking skill assessments (the metacognitive questions).

The teachers involved with the intervention appeared to report that the learners in the collaborative learning condition responded much more positively. Furthermore that they were more engaged and motivated to think than those children in the individual learning condition. This study echoes data from other research articles correlating collaborative learning with higher task-motivation (e.g. Gokhale, 1995). However, it should be noted that both conditions benefitted greatly from the intervention in terms of the underpinning pedagogy of effective thinking lessons, by learning thinking skills explicitly, being able to metacognitively reflect on their thinking processes and recognising when it is appropriate to transfer those skills to other contexts.

8.5 Approaches to Evaluate Improvements in Thinking Skills

One of the reasons why there are so many different types of thinking skills packages might be because, as yet, definitive research has not been gathered to highlight the

benefits of adopting one particular approach over another. In Chapter 3 a number of thinking skills programmes were analysed in relation to the content, method, pedagogy and existing research to support various approaches. Pithers and Soden (2000) believe that the lack of a widely accepted definition of the elements involved in effective thinking, “leads to confusion about how good thinking might be assessed; assessment and evaluation of critical thinking has been sorely neglected worldwide” (p. 239). Whilst opinions on the effectiveness of specific evaluation methods vary, the majority of theorists agree that thinking skills are inherently difficult to measure.

The third study in this thesis attempted to address these difficulties by using a combination of standardised and intervention-specific measures to evaluate the effectiveness of the thinking skills intervention devised. The data gathered from the standardised measures used supports the view of many theorists who believe that such tests are often too broad to detect slight changes in thinking capacities (Asp, 2001; Beyer, 1987; Costa & Kallick, 2001; Fisher, 2001; Kirkwood, 2005). Whilst the study used qualitative measures to analyse teachers’ and children’s concepts of intelligence and effective thinking, the responses to these were analysed quantitatively using content analysis. In using the combined approach, this study attempted to reconcile many of the difficulties experienced by other intervention studies.

The most important contribution from this thesis regarding the evaluation of thinking skills comes from the success of the specially designed thinking skills assessments. In this respect these findings give strength to Beyer’s (1987; 2001c) and Kirkwood’s (2005) argument that assessments designed to test the skills being taught will produce the most insightful findings. Furthermore, although the specific Thinking Skills Assessments and ITs used in Study 3 were adapted specifically for the intervention, the format devised was based on widely accepted tried and tested assessments, found to be successful elsewhere (i.e., Beyer’s six task format).

This thesis therefore supports Beyer's assertion that individual skills can be measured by asking learners to first define the thinking skill, correctly identify an example of the skill being used, apply the skill and then metacognitively reflect on how well the skill was applied. Perhaps the metacognitive evaluation was one of the most important aspects to have fostered, if Burke's advice is to be taken:

We must constantly remind ourselves that the ultimate purpose of evaluation is to have students become self-evaluating. If students graduate from our schools still dependent upon others to tell them when they are adequate, good, or excellent, then we've missed the whole point of what education is about.

(Burke, 2001, p. 532)

Study 3 also incorporated a final question to determine if learners could identify other contexts where the skill could be applied. It is a format which can be adapted for the majority of thinking skills (Beyer, 2001c) and also tailored to varying levels of cognitive abilities.

It is important to note, however, that this thesis is not implying that a standardised measure can never detect change in thinking skills ability – simply that the standardised measures used for this thesis were not sensitive enough to measure the specific thinking skills taught during the concentrated intervention and that the individually designed measures were more effective for this study. Aiming to devise an assessment which is standardised and specific enough to measure change in individual thinking skills taught would be a worthy endeavour. As Resnick argues, “We must develop forms of assessment that are more suited to the nature of the abilities we seek to teach” (1987, p. 47)

8.6 Limitations of this Thesis and Suggestions for Future Research

This thesis highlights the need for more research to be conducted to ascertain teachers' and children's conceptions of effective thinking. Whilst a variety of research exists on teachers' and children's understandings of intelligence which

enabled comparisons with findings from Studies 2 and 3 to be made, as yet, there is not a similar body of research with which to compare the findings associated with concepts of effective thinking.

A further note of caution must be made with respect to concluding that children can improve at thinking skills representative of the main thinking types. As discussed in Chapter 1, categorisation of thinking skills is deeply contested, and further conceptual clarification is needed to establish exactly what those main thinking types are. For the purposes of this thesis, all three studies were based strongly on the thinking skills within the frameworks of Swartz and Parks (1994) and McGuinness (2003). However, no single framework is as yet widely accepted as including all essential skills. This is particularly the case in regard to the age-appropriateness of thinking skills. Although some thinking skills depend more obviously on enhanced cognitive processes, very little advice is to be found on which thinking skills are appropriate for which age of children. Whilst Study 2 sought to examine in more detail developmental changes in children's understandings of individual thinking skills, there is no guarantee that the skills chosen for this study (and subsequently Study 3) were appropriate.

Furthermore, although Study 3 provides some data on the underpinning pedagogy of effective thinking lessons, all three studies in this thesis essentially examine thinking *skills*, and place a much lesser emphasis on the importance of dispositions. Studies 1 and 2 in particular analyse teachers' and pupils' concepts of thinking skills. Similarly, Study 3 only assesses the thinking skills, not the relevant dispositions which would be important factors in ensuring the use of the skills acquired. As many theorists argue that developing appropriate thinking dispositions is central to fostering individual thinking skills (e.g., Costa & Kallick, 2000; Halpern, 1997; Kirkwood, 2005; McGuinness, 2003; Tishman et al., 1995), future studies could devise an intervention that focuses as much on developing and assessing relevant thinking dispositions (which was a subsidiary aim of this intervention) as the skills themselves.

Dispositions cannot be transmitted like a piece of knowledge...It would be inadequate to approach the cultivation of dispositions by designing a lesson plan to teach dispositions as one would teach particular content or skills. While explicit lessons about dispositions can be useful, the need for an ongoing, comprehensive, environmental approach cannot be neglected.

(Tishman et al., 1995, pp. 40 - 41)

Similarly, although the data gathered indicated that children in both experimental conditions understood when it would be useful to transfer their knowledge of skills elsewhere, this study did not gather data to determine whether the learners were actually applying these skills in other contexts. Whilst the ability to transfer thinking skills is intrinsically hard to evaluate, such data is necessary to determine when and how transfer occurs. A similar note of caution was made regarding the claim Study 3 made that it had succeeded in developing learners' metacognitive awareness. Although the findings clearly indicated that the learners involved in the intervention had vastly improved their ability to reflect on the thinking processes they had employed to carry out a thinking skill task, this finding does not begin to suggest that learners had improved their metacognitive ability whilst 'on-task'.

In Chapter 3, a variety of programmes and corresponding research were surveyed. The different ways of teaching thinking skills were highlighted and a conflict shown about how best to teach thinking skills (i.e., discretely or by infusion). However, this thesis did not attempt to answer these issues. The essence of the lesson template used in Study 3 was based on the core elements identified in Chapter 3 and founded on the underpinning pedagogy of the infusion approach; developing an appropriate language of thinking; fostering dispositions and metacognition; and encouraging learners to transfer those skills to other contexts. Study 3 primarily did this by encouraging teachers to infuse the thinking skills into a variety of curricular areas. However, whilst the majority of teachers felt that as a result of the intervention they could then design their own infusion lessons, the actual intervention (whilst based on the infusion method) was not a true infusion study. To ensure that all four experimental teachers taught the same sequence and series of lessons to enable valid

comparisons to be made, the teachers were given structured lesson plans to use. In the true infusion method this would be conducted in a more informal way, as McGuinness (2000a, 2000b, 2005a) has, with individual teachers identifying contexts where it would be appropriate to infuse thinking skills alongside the subject content that the pupils would be taught regardless.

Perhaps one of the largest limitations of the intervention study reported in this thesis is that, whilst the intervention was shown to be successful on a number of study-specific outcomes, the study cannot make any claims regarding the impact this improvement made on general curricular attainment outcomes in school. To enable research to be conducted regarding the value that there is to teaching thinking skills, future interventions could attempt, as Adey and Shayer (1993) have, to assess the correlation between developing pupils' thinking skills with classroom outcome measures.

This thesis has made some broad claims about the effectiveness of collaborative learning when enhancing thinking skills. However, it has been discussed that many theorists believe that for collaborative learning to be successful a variety of factors must be controlled, such as developing appropriate collaborative learning skills in pupils. Study 3 did not attempt to investigate children's collaborative basic skills in relation to the effectiveness of the group work. Future research could focus more deeply on the conditions necessary to ensure a successful outcome (in relation to developing children's thinking skills) from collaborative learning. This might include a study which employed a control condition, collaborative learning condition (as in Study 3 with no prior input or training on the skills needed for collaborative learning), and a structured collaborative learning condition (which trains group members prior to the intervention, groups pupils for ability, gives each member of the group a particular role and specifically trains the practitioner to create an atmosphere conducive to collaborative learning).

Whilst this thesis made an attempt to further develop ways that improvement in thinking skills can be measured, this issue also deserves more in-depth investigation.

More research is needed to determine the effectiveness of the thinking skills assessments on a variety of thinking skills. Investigation would also have to focus on ensuring these assessments are age-specific. Furthermore, as previously discussed, the thinking skill assessments devised for Study 3 included a first look at the development of metacognition and children's ability to recognise when skills can be applied in other contexts. More research is needed to determine the change in learners' on-task ability in terms of actually being metacognitive continuously and being able to apply the skills learned in a variety of contexts without prompting.

This thesis has made some contribution into our understanding of children's theories of intelligence, building on the work of theorists such as Yussen and Kane (1985), Kurtz-Costes et al. (2005) and Dweck (1999), and produced novel data regarding theories about effective thinking. Findings have indicated that teachers' and learners' concepts of cleverness and good thinking can be challenged successfully through a structured intervention. The intervention was based on addressing teachers' methodology, through the use of key open-ended questions put to the children. However, as discussed in Chapter 2, some theorists believe there to be a variety of factors which influence children's theories, including the assessment procedures used in the classroom and the praise given to learners, the influence of which was not analysed in any of the three studies. It would therefore be a worthwhile aim of future studies to gather comparative data on children's concepts of what it means to be a 'good thinker'. Furthermore, to identify whether children's concepts can be challenged successfully by looking specifically at the types of praise practitioners give to pupils and investigating the link between intelligence, effective thinking and developing helpless or mastery-oriented responses in learners.

It was outwith the scope of this thesis to conduct longer-term studies. However, it would be a valuable exercise to conduct studies similar in format to each of the studies carried out in this thesis, but with a view to assessing the impact on a larger scale. For instance, teachers' perceptions were analysed in Study 1 prior to the staff having had any explicit training on thinking skills. Since this study, many schools are now working towards embedding 'effective thinking' into all aspects of the

curriculum in line with the National Priorities, *A Curriculum for Excellence* and School Improvement Plans. It would therefore be interesting to discover if this baseline measurement has improved as a result of the raised profile of thinking skills (i.e., in terms of range of thinking skills taught in a variety of curricular areas and whether developmental trends have emerged). It would also be of interest to discover the extent to which practitioners believe they are teaching 'higher-order' skills to higher achieving learners, something which was not investigated in this thesis. Similarly, and as a result of this increased awareness of 'thinking skills', it would be a worthwhile endeavour of future studies to discover if children's understandings of cleverness and good thinking have deepened (e.g., whether they still view 'cleverness' as being synonymous with 'knowledge', and are still uncertain about the cognitive processes to employ when asked to 'think harder'). Furthermore, it was beyond the scope of Study 3 to be able to gather longitudinal data on whether the teachers and children retained their knowledge of the thinking skills learned and whether it was evident in classroom practice. Future research should therefore seek to extend the successful format used in Study 3 by conducting longer-term studies with delayed post-testing to see if gains are maintained and whether practitioners are regularly integrating the key elements of effective thinking lessons into their daily classroom practices, and whether these lessons permeate the curriculum.

8.7 Educational Implications

If the above arguments are sound, this thesis can be expected to have obvious and significant implications for policy (including the link between the 5 –14 curriculum and *A Curriculum for Excellence*) and practice (including support, training and the importance of developing appropriate teaching methodologies).

The introductory chapters highlighted one of the key aims of this thesis: to explore both teachers' and children's current perceptions of thinking skills within the curriculum, something which few studies have attempted to discover. The 5 – 14 curricular guidelines were illustrated to encourage practitioners indirectly to include thinking skills into their teaching of various subjects. As such, this thesis explored the impact of these guidelines in terms of teachers' perceptions of the frequency with

which they attempted to develop children's thinking skills across the curricular areas from early to upper primary. Uncovering established good practice is fundamental to the success of any educational initiative attempting to build on prior developments in schools. In Scotland, *A Curriculum for Excellence* (ACE) is currently being viewed as the vehicle through which the 5 – 14 guidelines will be enhanced. As such, recent educational initiatives (such as the thinking skills initiative, Enterprise in Education, Race Equality, Creativity, Assessment is For Learning), are reflected in ACE (2004). For example, learners are encouraged to “apply critical thinking in new contexts”, to “solve problems”, to “make informed choices and decisions”, to “think creatively and independently” and also to “create and develop”. Yet this thesis has shown that, at a fundamental level, teachers and children are not fully aware of the strategies and thinking processes in their heads to associate with many of these broad requests. This suggests that to ensure the success of ACE, a lot of ground-work will need to be put in place before the vision of “successful learners, confident individuals, responsible citizens and effective contributors” is realised. At present, findings from this thesis suggest that many practitioners would be unsure of *how* to think critically and creatively and uncertain as to the processes involved in problem solving and decision making.

One of the main messages from the research conducted within this thesis is that, at present, there is a gap between policy aims and *how* practitioners should be developing thinking skills in a bid to realise those aims. Clearer practical guidance is needed for practitioners to bridge the gap. From early – upper primary it is essential that a coherent progression of skills is taught across the curricular areas. This need for continuity, breadth and depth in learning was reflected in the 5 – 14 guidelines which attempted to break down each subject by levels, strands and attainment targets, and through which each child would progress. Whilst the National Curriculum (2002) in England has assimilated many thinking processes into a single framework to be promoted in learning environments, at the theoretical level there is not yet a widely accepted framework which can be used in schools. Schools and local authorities must therefore first identify a framework to be promoted in schools, only then will it become possible to identify and sequence a progression of thinking

skills from early years to secondary school. Schools should be cautious about this, however, and take notice of the frustration which many practitioners found when faced with the rigid structure of the 5 – 14 guidelines. Findings from all three studies imply that teachers need clearer guidance on how to teach thinking skills for continuity and progression from early years through to secondary school, particularly as children appear to understand them developmentally. Beyer (2001a) identifies core elements involved in this process. For example, selecting the thinking skills to be included in a ‘Thinking’ curriculum, ordering the skills and strategies by grade level and subject area, structuring the ‘scope and sequence’ of the identified skills to ensure breadth of skills covered, identifying a progression from simple to complex skills and avoiding excessive skill injections at each grade level (p. 251). This would mean that practitioners would have a starting point for teaching thinking skills, differentiating where appropriate.

Once local authorities have agreed on thinking skills to be taught, the issue then arises of how to teach thinking skills. Rather than selecting a single package to teach, Study 3 has shown that when teachers’ methodologies make core thinking skills and strategies explicit and weave them into a pedagogy which focuses on the language of thinking, metacognition and transfer, learners will understand more about what it means to be a ‘good thinker’ and will improve at applying thinking skills.

By secondary school, the majority of children view ‘cleverness’ as being synonymous with the acquisition of knowledge. This common concept is then reinforced throughout secondary schools with a large focus still being placed on memorisation and accumulation of facts to acquire high marks on tests. It is important, therefore, that from an early age teaching practices (e.g., feedback, praise and classroom groupings) reflect incremental theories of intelligence, as these theories will have an impact on children’s understandings of this phenomenon. Many children being supported within educational environments currently are possibly unaware of what constitutes ‘good thinking’, tending to link this capacity to a more general cognitive ability. Future training needs to be put in place to deepen

practitioners' understanding of what is involved in 'good thinking' and how to convey and promote these aspects within their daily classroom practices.

This thesis also suggests that educational interventions can be put in place to support the teaching for thinking initiative, and identified an in-depth model of how to support practitioners with the incorporation of initiatives into teaching methodologies. The first step taken in this thesis was to investigate teachers' and children's current knowledge of what effective thinking means and understanding of individual thinking skills. The intervention model applied for the final study in this thesis built on these findings and provided participants with support, which included awareness raising, training, familiarisation of resources, modelling of good practice, on-going support, observations and feedback, continuous evaluation and reflection. Adequate staff training is therefore central to the success of sustainable educational interventions. Currently, it is common practice in many educational authorities to hold training sessions on the biannual closure days. Whilst it is difficult to provide class supply cover to conduct many training sessions throughout the school day (and financial support to cover this), inviting participants to a one-off course twice a year does not address the issue of sustainability. The training put in place for Study 3 avoided this pitfall by ensuring that the practitioners were continuously supported in practice and they were not 'left to get on with it' back in school. Furthermore, an effective way of supporting practitioners was through the creation of the informal e-mail network. Establishing a network proved to be an extremely successful way of communicating informally throughout the intervention to ensure that none of the teachers involved felt isolated. As the researcher corresponded regularly to informal comments and questions being discussed through the e-mail network it meant that she was immediately aware of any potential problems that were arising. Connected to the importance of supporting practitioners adequately to ensure the sustainability of initiatives, was the successful support strategy of first modelling the lessons to practitioners before asking them to attempt them. Unfortunately, in practice this becomes more difficult when there are a large number of teachers to be trained. However, one way to combat this is through videos of good practice – not necessarily showing an 'expert' conducting the lessons but trained primary teachers.

Although the intervention study designed for incorporation in this thesis strove to effect change in practitioners' pedagogical style rather than detect the change as a result of practitioners teaching a discrete resource, practitioners were also supported through the provision of resources in the form of lesson plans and teaching materials. This should only be a subsidiary aim of an educational intervention. It is unlikely that any intervention that aims to alter teaching methodologies significantly will do so successfully through distributing resources alone. However, when resources are viewed as a 'prop' to support the intervention initially (as was the case with the intervention study reported in this thesis), it has been shown to be an extremely effective method of support. The importance of adopting this in-depth model to roll-out initiatives is indicated in the comments which all four experimental teachers made. By the end of the intervention each teacher felt confident about infusing thinking skills into their daily classroom practices without the use of a prescriptive lesson plan, but following the core elements of making the skill explicit, fostering appropriate thinking dispositions, using thinking diagrams, developing metacognition and fostering transfer of the skill to other areas.

Practitioners need to be fully supported to encourage them to portray the core elements of effective thinking through their teaching methodologies. As a result of the comprehensive training provided for the intervention teachers, the teachers were then keen to develop their own 'effective thinking' lessons. This would seem to be preferable to using a discrete resource whereby, once teachers have taught the last lesson in the manual, they are unsure of how to carry on that style into their daily classroom practice as the lessons have been so prescriptive. Perhaps a hybrid model, combining the infusion and the discrete approaches would be possible, with the skills learned in context-free situations and then reinforced and infused throughout the curricular areas. Perhaps as Sternberg argues, "Ultimately, the most profitable program of instruction will probably be one that combines the best elements of the various approaches" (1987b, p. 5).

When basing an educational intervention on the elements identified with effective thinking, improvements can be made in children's thinking ability. Surprisingly,

these improvements were seen regardless of whether the lessons were taught incorporating individual or collaborative learning. These results may be of particular interest to practitioners who find collaborative learning particularly difficult to manage. In these instances, teachers should be encouraged to teach for thinking as a first step. Once they feel confident at teaching effective thinking lessons they can then try to make collaborative learning a bigger part of their teaching methodology, being supported by in-depth training.

A Curriculum for Excellence is attempting to make links between recent policy developments, and whilst the place of thinking skills within it is accepted, developing effective thinking should not be viewed as an isolated development from developing children's capacity to be independent, enterprising and able to reflect on and assess their own learning (i.e., AiFL). It is important that, in schools, practitioners are encouraged to see the links between these initiatives and explore the relationship between them in practice. For example, to become 'enterprising', children must also be able to apply thinking dispositions, to make good decisions and solve problems. In line with the AiFL initiative, children should be able to reflect on strategies applied and their thought processes with a view to improvement. Furthermore, to create 'responsible citizens' (in line with the global citizenship agenda) pupils must be able to reflect critically and determine bias. Therefore, the thinking skills initiative should not be viewed in practice as a separate entity from these other national initiatives, but rather one that will enhance the effectiveness of many other policy developments.

8.8 Summary and Concluding Comments

As well as adding strength to our understanding of children's concepts of intelligence, this thesis has provided a much-needed contribution to the literature on teachers' and children's definitions of effective thinking and specific understanding of individual thinking skills. Furthermore, the findings from the intervention study (Study 3) have the potential to influence the way thinking skills are taught and assessed, areas which at the moment remain deeply contested.

At present, many theorists believe that certain elements (e.g., the language of thinking, thinking dispositions, teaching the skills, encouraging metacognition, transfer and collaborative learning) ought to form the basis of teaching for thinking. This thesis supports this assertion by showing that teaching methodologies incorporating these aspects are successful in deepening understandings of what it means to be a 'good thinker', making thinking visible in terms of the cognitive processes involved and increasing performance on individual thinking skill tasks.

Taken together these results not only support the claim that thinking is a capacity which can be taught successfully by focusing on individual thinking skill processes, but also that it is imperative that teaching is not merely about the teaching of discrete skills. In educational environments awareness needs to be raised about the core elements of effective thinking. In addition, further conceptual clarification is needed to provide practitioners with guidance on how to achieve a coherent progression of thinking skills on children's journey from early years through to later stages of education and indeed life outside school.

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APPENDIX A

STUDY 1: QUESTIONNAIRE TO DETERMINE TEACHERS' PERCEPTIONS OF THINKING SKILLS WITHIN THE CURRICULUM

APPENDIX B
STUDY 3: THINKING SKILLS ASSESSMENT
VERSION 2

APPENDIX C

STUDY 3: SCORING MATRICES FOR THINKING

SKILLS ASSESSMENTS AND ITS

APPENDIX D
STUDY 3: INTERVENTION TESTS (ITs)

Falkirk Council
Education Services

Audit of Effective Thinking Primary School

School: _____

Name: _____

Stage: _____

1. How would you define the term "effective thinking"?

2. In your opinion, do children **think** better working individually, in pairs or in groups? Please give reasons for your answer.

3. Do the children in your class seem to *prefer* working mostly as individuals or mostly collaboratively (i.e. either pairs or groups)? Please give reasons for your answer.

4. As a classroom practitioner, do you prefer to have the children in your class working individually or collaboratively? Please give reasons.

5. In terms of your classroom practice, please rate the extent to which you utilise the following strategies:

(1 = do not use, 2 = use rarely, 3 = use sometimes, 4 = use often, 5 = use all of the time)

Please try to put a score in every box below

[illegible]

[illegible]

Type of Thinking	English	Maths	Science	Technology	Social Subjects	R.M.E.	P.S.D.	Health Ed.	Music	Drama	P.E.	Art & Design
Predicting the likely consequences												
Weighing up the pros and cons												
Deciding on a course of action												
Reviewing the consequences												
Metacognition How often do you provide opportunities for children to...												
Plan their thinking?												
Monitor their thinking?												
Redirect their thinking when necessary?												
Evaluate their thinking?												

(C. McGuinness, 2003)

Thank you for taking the time to complete this questionnaire.

THINKING SKILLS ASSESSMENT - VERSION TWO

Name: _____ Today's Date: _____

Name of School: _____

Teacher: _____ Class: _____

Date of Birth: _____

- 1) Match each skill on the left with what it means. Do this by writing the number of the correct skill meaning after the letter of each skill name in the Answer Grid box below.

SKILL NAME	MEANING
A comparing and contrasting	1 choosing one thing from a number of possible things
B grouping	2 thinking of new or different things
C solving problems	3 separating what someone wants me to believe from why he/she wants me to believe it
D coming up with ideas	4 putting things in the order they happened
E making decisions	5 putting things together that are alike in some way
F finding reasons and conclusions	6 finding how things are similar and different
	7 finding a solution to a difficulty
	8 telling what is likely to happen next

Answer Grid	
A =	D =
B =	E =
C =	F =

Please Turn Over

- 2) Match each skill on the left with the example of it being used. Do this by writing the number of the correct example of the skill being used after the letter of each skill name in the Answer Grid box below.

SKILL NAME	EXAMPLE OF SKILL BEING USED
A grouping	1 My friend figuring out how to work her mobile phone.
B making decisions	2 My brother trying to separate what makes me think that the sport I claim is best, really IS best!
C finding reasons and conclusions	3 My friend thinking of all the places she could go on holiday.
D coming up with ideas	4 Considering which of two films I like better.
E solving problems	5 My teacher explaining why the book cover is the most important part of the book.
F comparing and contrasting	6 My brother putting books away in the correct library shelves.
	7 My dad selecting which car he wants to buy next.
	8 My uncle wondering what trouble he will get into if he is late home again.

Answer Grid	
A =	D =
B =	E =
C =	F =

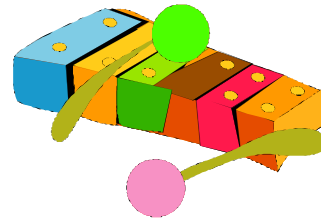
Please Turn Over

3) Compare and contrast the piano and the chime bars pictured in A and B, listing how they are alike and different below:

A



B



Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

Thinking Skills Assessment – Version 2

5) Sort these words into groups, showing your working in the space in the box below :

	steering wheel	air-hostess	car keys
bike jacket	runway		sun roof
helmet	pilot	handle bars	wings

Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Thinking Skills Assessment – Version 2

7) Imagine you are late for school. List as many possibilities for this happening as you can. Show your working.

Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface. The overall appearance is that of a clean, unused piece of stationery or notebook paper.

Thinking Skills Assessment – Version 2

9) **One** of the following examples presents a conclusion and reasons for believing the conclusion is true.

a) Find which example this is and circle its letter.

A

'Take That' is having a reunion tour. The tour will go round 12 venues in the UK. There used to be five band members until Robbie Williams left, and then there were only four. The remaining band members perform extremely energetic dance routines whilst singing their own songs.

B

Teaching is the best job in the world. You get to know lots of young children and to help them learn new things, which is very rewarding. It is amazing watching them grow and be able to do more advanced work - often as a result of the help you've given them!

b) Show your working either by marking on the above boxes, or by writing in the box below.



Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Thinking Skills Assessment – Version 2

11) You have won two tickets for a trip to Australia. Decide who you should give the other ticket to. Show your working.

Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

Thinking Skills Assessment – Version 2

13) It is the last day of school and you really want to give a present to your teacher. Unfortunately you broke the vase you were going to give her on the way to school. What will you do to solve this problem?
Show your working.

Please Turn Over

List these step-by-step as if you were telling them to a primary 5 pupil.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on its right side, suggesting it's resting on a surface.

End of Test

Scoring Matrix for Comparing & Contrasting Skill Questions

(Versions 1 & 2 no. 3; IT 1 no's. 3 – 5)

Key Steps of Comparing & Contrasting

- observing closely the items to be compared and contrasted
- identifying how the objects are similar
- identifying how the objects are different
- interpreting what is suggested by the similarities and differences

Refer to 'Key Steps' when scoring these questions:

Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none">▪ does not name or label the objects being compared▪ does not list any similarities or differences.▪ names features of only one object
2	<ul style="list-style-type: none">▪ states names of objects being compared▪ lists only 1 or 2 differences OR 1 or 2 similaritiesOR▪ lists vague features as being similar or different (e.g., states only that the objects are different colours, but does not give details as to HOW they are different)
3	<ul style="list-style-type: none">▪ states names of objects being compared▪ identifies at least 2 similarities and at least 2 differences▪ states in general terms only the nature of most of the similarities and differences (e.g., with regard to 'colour', object A is grey and object B is black).
4	<ul style="list-style-type: none">▪ states names of objects being compared▪ identifies at least 3 similarities and at least 3 differences▪ states specifically the nature of the similarities and differences (e.g., with regard to 'habitat, animal A is most commonly found in the wild, whereas animal B is a domestic animal).
5	<ul style="list-style-type: none">▪ states names of objects being compared▪ identifies at least 4 similarities and at least 4 differences.▪ uses precise language to describe the nature of the similarities and differences (e.g., with regard to 'colour', object A is mainly grey but has white triangular sections, and object B has patches of black surrounded by white).▪ states one thing suggested by the similarities and differences identified.

Scoring Matrix for Grouping Skill Questions

(Versions 1 & 2 no. 5; IT 2 no's. 3 – 5)

Key Steps of Grouping

- Scanning the data to find what the pieces are like
- Selecting some pieces that appear to be alike
- Putting these into a group
- Labelling the group with a word that means the feature common to all items in the group
- Adding other items that fit this name/label
- Repeating this process making new groups until all data are grouped

Refer to 'Key Steps' when scoring these questions:

Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none">▪ does not demonstrate any key steps of grouping▪ makes no more than 2 groups
2	<ul style="list-style-type: none">▪ groups together similar items in pairs, with no group labels given. OR <ul style="list-style-type: none">▪ draws lines between similar pairs of objects, without signifying the group label OR <ul style="list-style-type: none">▪ places all items into groups, but there does not appear to be a common theme within each group.
3	<ul style="list-style-type: none">▪ makes at least 3 groups▪ puts all items into groups▪ groups together some similar items, but not all of them.▪ does not label any of the groups. OR <ul style="list-style-type: none">▪ groups together some similar items, but not all of them.▪ labels at least one group inappropriately (i.e., the label does not indicate the feature common to all items). OR <ul style="list-style-type: none">▪ groups all items, but there is no coherence between the groups and / or some objects fit into or are placed into more than one group
4	<ul style="list-style-type: none">▪ makes at least 3 groups▪ clearly groups (e.g., by using lines, symbols or marks) all items appropriately▪ each item fits into only one group BUT <ul style="list-style-type: none">▪ but does not label all of the groups OR <ul style="list-style-type: none">▪ labels the groups inappropriately.
5	<ul style="list-style-type: none">▪ makes 3 or more groups▪ clearly groups (e.g., by using lines, symbols or marks) all items appropriately▪ each item fits into only one group▪ labels each of the groups appropriately.

Scoring Matrix for Finding Reasons & Conclusions Skill Questions

(Versions 1 & 2 no. 9; IT 3 no's. 3 – 5)

Key Steps of Finding Reasons & Conclusions

- read through (skim) the given paragraph, list, or text to
- find a sentence (or sentences) that tells what the author is trying to convince you to accept, believe or do. This is the author's conclusion.
- Find any / every sentence or phrase that tells WHY you should accept, believe or do this. These may be reasons.

Refer to 'Key Steps' when scoring these questions:

Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none">▪ does not select the correct passage
2	<ul style="list-style-type: none">▪ selects the correct passage which illustrates reasons and conclusions BUT <ul style="list-style-type: none">▪ does not indicate by writing out, circling, underlining, or marking the conclusion or any of the reasons.
3	<ul style="list-style-type: none">▪ selects the correct passage▪ identifies a conclusion OR at least one reason by writing it out, circling it, underlining it, or marking it in some way.▪ clearly labels each correctly
4	<ul style="list-style-type: none">▪ selects the correct passage▪ identifies a conclusion AND at least 1 reason.▪ clearly labels each correctly
5	<ul style="list-style-type: none">▪ selects the correct passage▪ identifies a conclusion AND at least 2 reasons.▪ clearly labels each correctly.

Scoring Matrix for Coming up with Ideas Skill Questions

(Versions 1 & 2 no. 7; IT 4 no's. 3 – 5)

Key Steps of Coming up with Ideas

- stating the purpose for coming up with ideas
- brainstorming many ideas
- grouping the suggested ideas and brainstorming new ideas for each of these groups
- adding new groups and brainstorming ideas to fit each new group
- combining groups into pairs
- brainstorming ideas that blend the main feature of each group in each pair

Refer to 'Key Steps' when scoring these questions:

Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none">▪ states only 0 – 1 ideas.
2	<ul style="list-style-type: none">▪ states between 2 – 4 ideas. BUT <ul style="list-style-type: none">▪ states ideas all closely related or on the same topic/type
3	<ul style="list-style-type: none">▪ states 5 or more ideas▪ states at least 2 different kinds / types of ideas (variety)
4	<ul style="list-style-type: none">▪ states at least 9 ideas▪ states a variety of ideas – at least 3 different kinds / types of ideas
5	<ul style="list-style-type: none">▪ states at least 12 ideas▪ states a variety of ideas – ideas representing at least 3 different types of ideas▪ states at least 2 ideas, each of which blends (combines) features of ideas of 2 other types / kinds of ideas previously listed.

Scoring Matrix for Problem Solving Skill Questions

(Versions 1 & 2 no. 13; IT 6 no's. 3 – 5)

Key Steps of Problem Solving

- stating the problem
- brainstorming possible solution strategies
- selecting a solution strategy
- listing the steps involved in the strategy / plan
- stating the intended solution
- stating how to check the solution and how well the plan has worked

Refer to 'Key Steps' when scoring these questions:

Scoring Code	<i>The pupil...</i>
1	<ul style="list-style-type: none">▪ does not demonstrate any key steps in solving a problem
2	<ul style="list-style-type: none">▪ writes down a solution without showing how he/she applied any key steps in a problem solving process
3	<ul style="list-style-type: none">▪ suggests one strategy to solve the problem <p>BUT</p> <ul style="list-style-type: none">▪ considers fewer than 3 solution strategies before selecting one to apply▪ lists only 2 or fewer of the steps involved in applying the selected solution strategy / plan.▪ does not describe how to check the intended solution to see if it will work <p>OR</p> <ul style="list-style-type: none">▪ lists a number of solution strategies to solve the problem but does not state why he / she discarded or accepted each.
4	<ul style="list-style-type: none">▪ states at least 2 or 3 strategies to solve the problem▪ lists most of the steps involved in applying the selected solution strategy / plan.▪ describes the intended solution <p>BUT</p> <ul style="list-style-type: none">▪ does not state clearly the problem to be solved.▪ does not state how to check how well the solution might work.
5	<ul style="list-style-type: none">▪ states clearly the problem to be solved▪ states at least 3 strategies for solving the problem.▪ lists the steps involved in applying the solution strategy / plan selected▪ describes the intended solution▪ explains how to check to see if the solution will work.

IT 1

Name: _____

School: _____

Date: _____

Thinking Skill: Comparing & Contrasting

1) Circle the letter in front of whichever of the following tells what

comparing and contrasting means:

- a. Grouping items
- b. Coming to a conclusion
- c. Finding similarities and differences

2) Tell me if each of these people is **comparing and contrasting** by

circling your response at the end of each description:

- a. My friend trying to work out whether to wear a dress or
trousers yes/no
- b. My mum trying to persuade me to eat healthily yes/no
- c. My brother thinking up ways to build a car from lego
yes/no

3) Compare and contrast what is shown in each of these pictures - and list your findings in the space below them:

A



B



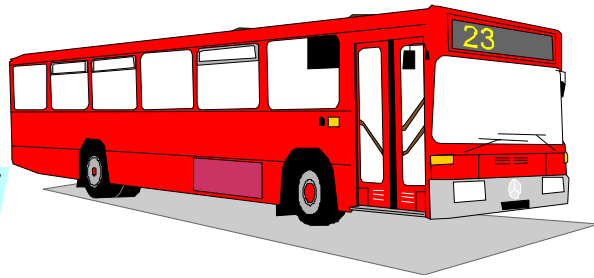
Please Turn Over

4) Compare and contrast A and B and list your findings below:

A



B



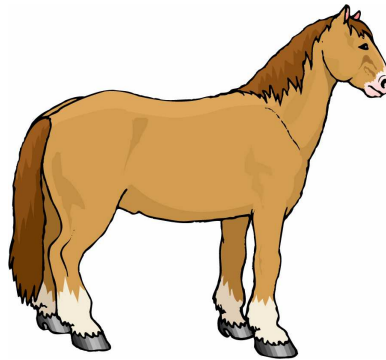
Please Turn Over

5) Compare and contrast these two animals and list your findings below:

A



B



Please Turn Over

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a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

g) _____

END OF TEST

IT 2

Name: _____

School: _____

Date: _____

Thinking Skill: Grouping

1. Circle the letter in front of whichever of the following tells what **grouping** is:
 - a. Finding an answer to a difficult problem
 - b. Putting things together that are alike in some way
 - c. Saying what probably will happen next
2. Tell me if each of these people is **grouping** things by circling your response at the end of each description:
 - a. My friend figuring which tree is taller yes/no
 - b. My gran putting her needles, thread and scissors into compartments holding only similar things yes/no
 - c. My sister choosing which TV show to watch yes/no

3) Sort these words into groups, showing your working in the space

in the box below :

bakery	supermarket	chemist	fishmongers
card shop	sports shop	shoe shop	butchers
corner shop	bag shop	clothes shop	DIY shop

- 4) Sort these words into groups, showing your working in the space in the box below :

tree **boat** bird soil **star** flower
river **hedge** fish cloud ripples
plant truck sun **airplane**

5) Group these words, showing your working in the space in the box below :

gymnastics	football	golf	badminton
ice-skating	swimming	clay-pigeon shooting	
rugby	horse riding	squash	
	wind-surfing	judo	

-
- This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface. The overall appearance is that of a clean, unused piece of stationery or notebook paper.

- a) _____
- b) _____
- c) _____
- d) _____

e) _____

f) _____

g) _____

END OF TEST

IT 3

Name: _____
School: _____
Date: _____

Thinking Skill: Finding Reasons & Conclusions

1. Circle the letter in front of whichever of the following tells what

finding reasons and conclusions means:

- a. Finding similarities and differences
- b. Grouping things together
- c. Separating out what someone believes from why they hold that belief

2. Tell me if each of these people is **finding reasons and conclusions**:

- a. My uncle trying to find out why I want to take up a particular sport

yes/no

- b. My cousin telling me what to do

yes/no

- c. My dad asking me to choose his work tie

yes/no

3) **One** of the following examples presents a conclusion and reasons for believing the conclusion is true.

a) Find which example this is and circle its letter.

A

Everyone should exercise three times per week. Exercise keeps your whole body healthy and your mind alert. Taking part in exercise with other people can help you to make friends and have fun.

B

I was walking down the street when I came across a toy truck lying in my path. I picked up the truck, cleaned it and then took it home with me. The truck has gone to a good home and my nephew now enjoys playing with it everyday.

b) Show your working either by marking on the above boxes, or by writing in the box below.



Please Turn Over

4) **One** of the following examples presents a conclusion and reasons for believing the conclusion is true.

a) Find which example this is and circle its letter.

A

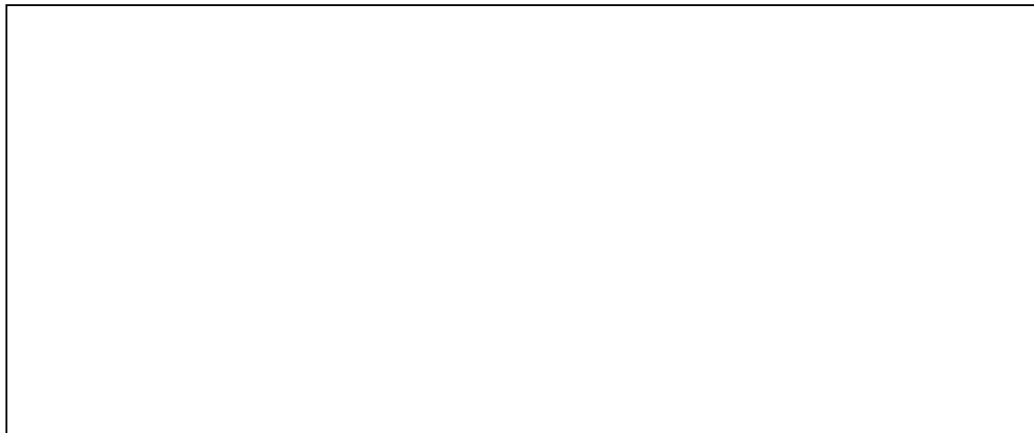
At Christmas time people put up decorations and give each other presents.

Words connected to Christmas are trees, stars, donkeys, Mary & Joseph and Baby Jesus. In schools young children often put on Nativity plays.

B

It is very important to give money to charities. Many people in the world are starving and thirsty, and often there are not proper medicines to help them when they get sick. If the people in these countries had more money they could buy food, clothing, medical supplies and equipment for schools.

b) Show your working either by marking on the above boxes, or by writing in the box below.



Please Turn Over

5) **One** of the following examples presents a conclusion and reasons for believing the conclusion is true.

a) Find which example this is and circle its letter.

A

When you first arrive at secondary school you will probably be nervous. But although it will be quite scary, just remember that you're going to be learning lots of new things, and meeting lots of people and that being at school will mean that you have a better chance of getting a good job. So try not to worry about leaving primary school and instead look forward to the next stage in your life.

B

- Do not run in the corridors.
- Do not put any other pupil in danger.
- Always try your best.
- Be polite and friendly at all times.

b) Show your working either by marking on the above boxes, or by writing in the box below.

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

g) _____

END OF TEST

IT 4

Name: _____

School: _____

Date: _____

Thinking Skill: Coming Up With Ideas

1. Circle the letter of the following which tells what **coming up with**

ideas means:

- a. Deciding what to do or say
- b. Making a prediction about the future
- c. Thinking up new or different things

2. Tell me if each of these people is **coming up with ideas** by circling

your response under each description:

- a. My friend thinking up excuses for not doing her homework

yes/no

- b. My mum writing a shopping list of things she needs

yes/no

- c. My brother choosing to play golf at the weekend

yes/no

Please Turn Over

3) List all the uses for a role of sellotape that you can think of.
Show your working.

Please Turn Over

4. You need to encourage people to buy from the healthy food tuck-shop in your school. List as many ways you can to make sure this happens. Show your working.

5. You need to make £10 to buy your favourite video game. List as many ways you can think of to make the money. Show your working.

Please Turn Over

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

g) _____

END OF TEST

IT 5

Name: _____
School: _____
Date: _____

Thinking Strategy: Decision Making

1. Circle the letter in front of the following phrase which tells what

decision making is:

- a. Putting things in the order in which they happened
- b. Using your imagination
- c. Choosing one thing from a number of possible things

2. Tell me if each of these people is **making good decisions** by circling

your response at the end of each description:

- a. My sister thinking of the pros and cons of available jobs
before taking on a Saturday morning job

yes/no

- b. My brother arriving late to school

yes/no

- c. My mum putting her knitting into different colours

yes/no

3) Your mum has asked you what you want most for your birthday.
Decide what you would like.

I decided I would like _____

Show your working.

Please Turn Over

4) Your class is to be given a pet to look after. Decide which pet you should get.

I decided we should get _____

Show your working.

5) Your teacher tells you that you can choose what to do for an afternoon in class. Decide what you would do.

I decided to _____

Show your working.

Please Turn Over

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

g) _____

END OF TEST

APPENDIX E

STUDY 3: INTERVENTION TEACHERS' COMMENTS FROM OPEN-ENDED QUESTIONNAIRE

General comments about the intervention:

- “I feel it has been a very positive experience” (Teacher A).
- “Collaborative group work has been very good for my class in terms of behaviour and task work – they have definitely embraced the principles, especially ‘taking time to think’ and ‘being precise’” (Teacher A).
- “For each new thinking skill the children responded enthusiastically. I have enjoyed teaching the skills. It has been a very positive experience” (Teacher B).
- “We have enjoyed the thinking skills” (Teacher C).
- “It has been interesting to take part in the intervention. The lessons were enjoyable and encouraged lots of creativity and use of imagination. The main ideas have been beneficial throughout the curriculum” (Teacher D).

Comments about the training days:

- “[The training days] were useful to share anxieties and worries about the programme. It helped to alleviate stress! Some of the skills were more difficult to grasp than others, and I didn’t really know a lot of the steps involved in each skill, so the training days were good to work through the ones that needed more explanation” (Teacher A).
- “The training days were essential. Looking at the overview of the pilot was helpful because I had no experience of using thinking skills and it gave a real insight. Made me less anxious about undertaking this pilot” (Teacher B).
- “Yes! The training days were useful. I needed the training to see what was to be delivered (although the book / manual was extremely supportive and easily provided all the info required)” (Teacher C).
- “The training days helped to clarify any difficulties. It was good to share views and ideas with everyone and also good to go through the lessons in the pack prior to using them and find out about the skills and the thinking steps involved” (Teacher D).

Comments about the lessons being modelled first:

- “These modelling lessons were very beneficial! Would not have been able to do some of the lessons as confidently without modelling” (Teacher A).
- “Having the skills modelled was excellent. It made me much more confident about how to teach the skills to the class” (Teacher B).
- “It was very important – it reminded me of all the things that had to be reviewed / repeated each lesson” (Teacher C).
- “I found it very beneficial to have the thinking skills modelled each week. This was due to the fact I was a little apprehensive and unsure at the beginning of the intervention. Therefore it was comforting to know I could see how the lesson should be done prior to doing it myself” (Teacher D).

Benefits of the intervention:

- “Made me think about ‘thinking skills’. Made me evaluate / assess teaching strategies in a new / alternative way. Focused on ‘thinking skills’ as something pupils should know / be aware of” (Teacher A).
- “I feel I have more understanding of the different skills because of the training days and observing the skills being taught” (Teacher B).
- “It has encouraged me to ‘think’ about things in a more orderly manner. I find myself using bits of each lesson in my own life – e.g., problem solving etc.” (Teacher C).
- “Having a thinking skills pack, discussions with other adults involved with the intervention, I have improved my own thinking as I now take more time and keep persisting. It has improved the quality of my teacher and my motivation towards the children whilst teaching” (Teacher D).

Teachers’ perceptions of benefits for their classes included:

- “They are more organised thinkers, especially taking time to think, persevering and being precise. Collaborative group work has helped their behaviour, attitude and focus” (Teacher A).
- “The class have had an experience they would not have had if I had not taken part. I will use these skills in other lessons. Children are more aware of how to be a good thinker and why they should not give up on difficult tasks. They can take these skills to high school with them” (Teacher B).
- “I have found that they are more likely to have a go – to try out new ideas, to persevere, to take more time to think about what is being asked of them and then trying to find other ways of improving for themselves” (Teacher C).
- “Their thinking has improved. Their knowledge of language has also increased” (Teacher D).

Difficulties teachers found with the intervention pilot:

- “Time management” (Teacher A).
- “Time – because it was a very busy term it was difficult to fit in so many lessons each week” (Teacher B).
- “Time! It was very challenging rearing the timetable to accommodate all the lessons and the IT in a week. Also there was a great deal of photocopying as my class had to have a thinking diagram each” (Teacher C).
- “Fitting lessons into the timetable” (Teacher D).

Difficulties teachers identified for their classes:

- “Time management, and they disliked the Thinking Diaries” (Teacher A).
- “They were feeling tired by the end of the study” (Teacher B).
- “The children would have preferred to have ‘group’ lessons as they enjoy working together” (Teacher C).
- “Sitting in silence whilst working individually” (Teacher D).

Impact of intervention on classroom practice:

- “I will now use organisation of ‘thinking’ to provide more opportunities and different opportunities for pupils. I will also be more inclined to offer collaborative opportunities and now I know, I can reinforce to the children the elements involved in being a good thinker” (Teacher A).
- “Although the children work in groups for different aspects of the curriculum, I feel more confident about managing group work. I think my questioning has also improved” (Teacher B).
- “I now give my class a proper ‘thinking’ time and try to encourage them to be more precise in their answers, pushing them to ‘look beyond’ their first answer” (Teacher C).
- “I now give the children more time to think. I encourage everyone to have a go whether they are right or wrong. I encourage the children to find different ways to do things rather than just the first idea that comes into their head” (Teacher D).

Recommendations for future interventions:

- “Thinking diaries only once per skill or perhaps a shorter version” (Teacher A).
- “Instead of running it for eight weeks it might be good to try splitting it into three ‘3-week’ blocks perhaps over three terms” (Teacher B).
- “Have a longer period so that the lessons could be more spaced out” (Teacher C).
- “Use only one thinking diary per week. Also maybe try doing three different thinking skills consecutively in the same week, rather than the same skill. Mix them up? Not sure, maybe this would confuse the children actually” (Teacher D).

Action as a result of being involved in the pilot:

- “To continue to offer opportunities to present class to use skills individually and / or within context. Also to consider how to integrate into teaching programme next year. Really enjoyed doing this – glad I was part of the pilot study!!” (Teacher A).
- “Use the thinking diagrams in as many areas of the curriculum as possible” (Teacher B).
- “I intend to use this pilot as part of my future class practice and will be doing thinking skills lessons again next year” (Teacher C).
- “I will use the structures from the thinking diagrams for future lessons. I will also be encouraging the children to take time to think during all lessons and continue to use the language from the thinking skills” (Teacher D).